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Advertisement Index, see page xxviii.

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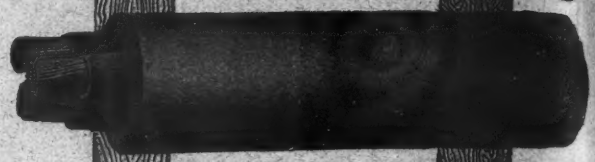

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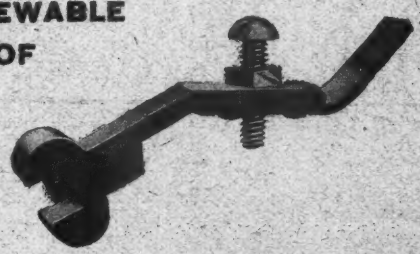

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THE

ELECTRICAL REVIEW.

VOL. LXXX. JUNE 8, 1917. No. 2,063

ELECTRICAL REVIEW.

Vol. LXXX.] CONTENTS: June 8, 1917. [No. 2,063.

	Page
Recruiting and Experience	617
Galalith on Tour	618
Development of the Redditch Electricity Undertaking (*illus.*)	619
Some Notes on the Measurement of the Insulation Resistance of a Live Three-Wire Network, by G. W. Stubbings (*illus.*)	620
New Electrical Devices, Fittings and Plant (*illus.*)	622
Correspondence—	
Static Sub-stations	623
Trade after the War	623
"Business as Usual"?	623
War Items	624
Legal	624
Some Patent and Trade Mark Cases	625
Business Notes	626
Notes	629
Reviews	631
City Notes	633
Stocks and Shares	635
Market Quotations	636
Exports and Imports of Electrical Goods during March and April, 1917	637
A Concentric Standard Dynamometer Wattmeter and Non-Inductive Standards of Low Resistance, by A. E. Moore (*illus.*)	637
Reinforced Concrete Transmission Poles (*illus.*)	639
The Importance of Hygienic Factory Conditions	640
New Patents Applied for, 1917	640
Abstracts of Published Specifications	640
Contractors' Column ... ... Advertisement page	xxii

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RECRUITING AND EXPERIENCE.

WHEN the House of Commons was about to adjourn for the Whitsun recess, the Prime Minister announced the intention of the Government to set up seven Commissions to inquire into the causes of Labour unrest. We trust that that important inquiry is now in progress, for upon the result of its investigations very much may depend. But it would be unwise were silence to be preserved respecting another form of unrest which, while it does not demonstrate or parade itself in the same ways, is undoubtedly very prevalent in not unimportant quarters. This particular unrest would probably be better described as uncertainty and the spirit of unsettlement that it entails.

It is, of course, recognised that in times when hardly anything or anybody can fairly expect to escape the moulding influence or chiselling of tragedy and sacrifice, and when there are ever-changing factors emerging, there can be no rigid or continuous policy in respect of detail. There may even arise emergencies when large policies may have to undergo revision so long as vital principles are not endangered. To millions of us there are many matters connected with the war which are, and probably will long remain, obscure; it must be so, because the people as a whole cannot be told without the enemy knowing too. But it is excusable if the people are tempted to wonder, when certain courses of action are adopted, the reasons for which they are unable to fathom, whether the authorities themselves are not in doubt. Among the certain and very gratifying matters of recent date we find the intervention of America with vast resources of material and ships, and, sooner or later, with millions of young fighting men; also the lessening of the submarine peril. We have also been given to understand that there are millions of men of military age in various industries in the United Kingdom from which we are able to draw our required fighting forces as the work of substitution progresses. A member of Parliament, in a recent letter to the *Times*, put at six figures the number of young colliery workers who were available for release—many of them eager for service, while the older men and the people of their localities desired them to take their rightful place. The National Service movement called clamorously for men to volunteer for industrial service of many kinds. Two or three hundred thousand applied, some thousands were found positions, and now little is being heard of the matter save by means of poster or hoarding.

A month ago an invitation was issued by the War Office calling for men above the recognised and Parliamentary military age to volunteer for various classes of service. This proposition, however, has not yet matured. Whether the announcement was premature or ill-considered, or whether something developed of which the country was in ignorance rendering that particular step undesirable, we, of course, cannot know, but all these things working together have been responsible for that kind of unrest or uncertainty that we find to be so prevalent among the older men who have been for several years, and are now, bearing the stress and strain of commercial and industrial life. The latest phase of the matter is the decision of the Army Council to have pink forms prepared of all registered men who are between the ages of 41 and 49. As usual, the

newspapers have their different versions of what this move means. Some seem to consider it as the prelude to the introduction of compulsory military service; others suggest that particulars as to the occupations of the men in question are required, which may indicate some form of industrial service as being intended, but without any indication of enlistment in the near future. The latter view is more intelligible to the layman than is the former, for he wants to know what progress is being made with the efforts to release the younger men from industrial pursuits, and to what extent American fighting men may be counted upon at an early date. We naturally see that it is one of the weapons of war to mystify the enemy, confusing him as to our immediate strength, and as to our reserves and their source. Yet we have to remember how unsettling is the effect of the present uncertainty upon commerce, finance, and many branches of industry.

The average man perceives the strongest possible reasons against raising the military age a single year until the younger men who are engaged in work in which substitution is possible have had the opportunity of using that physical strength and adaptability in which they are naturally the superiors of their elders. Not the least disturbing element in the uncertain situation is its effect upon the numerous businesses which are already bearing voluntarily liabilities or obligations in respect of those who on leaving their employment temporarily to take up active service had their salaries in part maintained. Firms who carry this voluntary burden, and pay all the necessary war taxes, find themselves faced with the possibility of their older and higher salaried men, and their principals, too, being called to the Colours, and there is a limit to their ability to supplement Army pay. Furthermore, they have rearranged their businesses in keeping with changing events, advertising for and engaging men above the military age. These men have just got into the running, and they, too, become liable at the same time as the managers and others who, by long experience and service, have been maintaining the businesses which have enabled the fighting men's allowances to be paid. As the *Times* pointed out recently, for every head of an important business between the ages of 30 and 40 there may well be a hundred between the ages of 40 and 50. We believe that if the leaders of industry were consulted on this point by the Army Council, or by the War Cabinet, whichever is responsible in such a case, they would be able to give very striking evidence in support of that statement. We have to win the war. That is the prime consideration of all of us, but shall we not be more likely to wage it more effectively if we minimise as much as possible any further interference with industry and trade? The Minister of Munitions has desired to introduce dilution in private industry in order that such industry shall remain as far as possible efficiently intact in readiness for our returning forces. But we cannot take the heads, the managers, the men of experience in such connections, those who, too, maintain businesses, earn profits, and pay allowances and heavy taxes, without seriously hampering the industrial machine. We greatly admire the valuable service that women are rendering in clerical work and in mechanical operations in engineering and other industry, but you cannot train women or fresh older men to take the place of such men as we have indicated.

Sir Wm. Robertson has said that we are making a 75 per cent. effort at home supporting the 25 per cent. effort of the Naval and Military Forces. Both he and the Prime Minister, too, have expressed their convictions concerning the Press as an essential part of the nation's fighting organisation, an admission, we believe, that there must be certain important discriminations exercised unless the efficiency of the 75 per cent. home effort is to be seriously impaired. In the *Newspaper World* recently we read a fully-informed article in which it was shown that if the Tribunal rules of the past year are to be applied in connection with any possible compulsion in the case of men of 41 to 50, it will be impossible to publish hundreds of weekly newspapers, and many of these are essential for the purposes of those engaged in munition-making industries and for maintaining trade connections in readiness for after the war. The Stock Exchange, too, has been much perturbed by the prospect which threatens to take the older men who are maintaining that institution. It is even said that if these men "go" the Stock Exchange must practically close. We cite these two types of cases as forceful examples of many others in general industry proving the need for the most careful discrimination unless we are going to work little short of financial and industrial disaster.

Let us quote one more: The chairman of the Kalgoorlie Electric Power & Lighting Corporation, Ltd., recently spoke as follows concerning the feeling of the company's tramway manager that he must respond to the call for volunteers:—

> Sir Wm. Robertson agreed the other day with a statement that the Military and Naval Forces are doing 25 per cent. of the work required to keep the war and the Empire going successfully, and that 75 per cent. of it is being done by the rest of the population. Assuming this to be correct, it is clear that the men who are in charge of important civilian work necessary to hold the industries of the Empire together and produce some of the sinews of war are already doing the best they can do for their country, and should stick to their work. From this aspect, selective compulsory service seems to be better for the country than the voluntary enlistment of men experienced in business and technical affairs who are already more effectively employed.

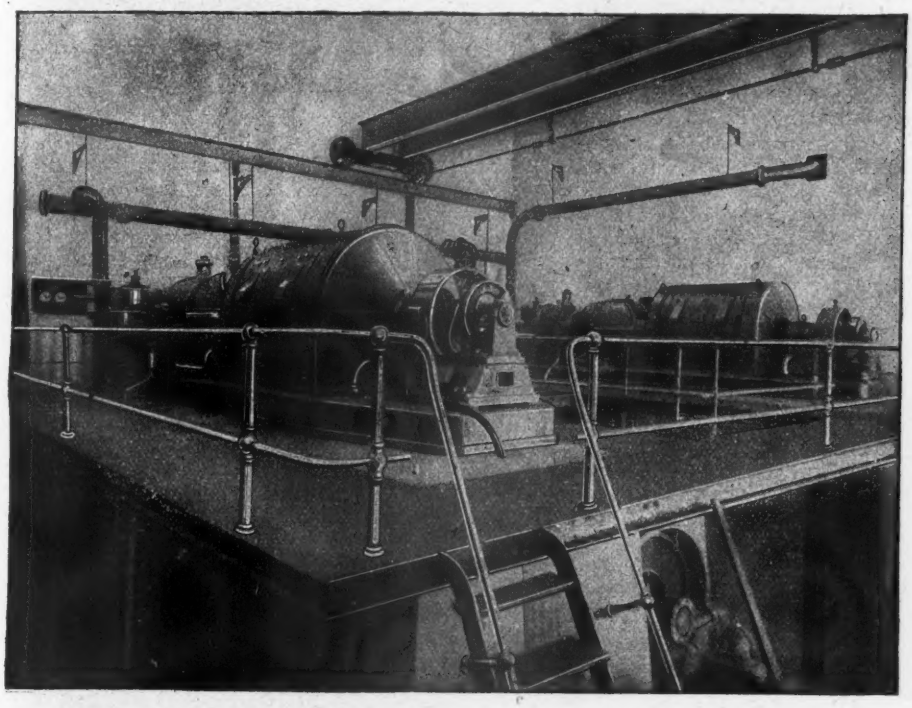
We have, perhaps, touched upon a subject which is a little removed from our ordinary concerns, but we do so because we consider it desirable that the present uncertainty should be removed, that the trade and industry, commerce and finance, of the country should be protected, and that all possible measures should be taken to insist upon the young men taking their rightful place. To secure the last of these ends cannot give rise to further discontent in Labour circles, for the raising of the age may often mean that the older men will be called to fight the while the younger men—perhaps even their own able-bodied sons—are allowed to stay at home.

Galalith on Tour.

We remember reading somewhere, long ago, the story told by a journalist of a paragraph which he had perpetrated, and which, reproduced in succession by one journal after another, had circulated through the Press of the entire English-speaking world. During recent months we have witnessed a similar sequence of adventures in connection with the insulating material known as "Galalith," a German product made from milk, which we introduced to our readers in 1912. A paragraph describing galalith, as though it were a novelty, recently went the round of the English and American technical Press, and has just cropped up once more in the *Electrical World*, which quotes it from the *Electrician*. We have watched its progress with increasing interest, wondering the while whether some exceptionally able advertising agency were at work, or whether the editorial staffs of our many contemporaries were troubled with short memories. Owing to its German origin, galalith, we believe, cannot now be obtained in this country, but we may remind our readers that in April, 1915, we drew their attention to a British substitute (then known as "Kasenoid," but now called "Erinoid"), also made from milk, and designed expressly to take the place of galalith. We cannot but regret that the latter has, somehow, achieved so effective an advertisement.

DEVELOPMENT OF THE REDDITCH ELECTRICITY UNDERTAKING.

We recently referred in our "Notes" to the remodelling of the electricity supply arrangement of the Redditch Urban District Council, with a view to meeting the growing demand for cheap power in the area.



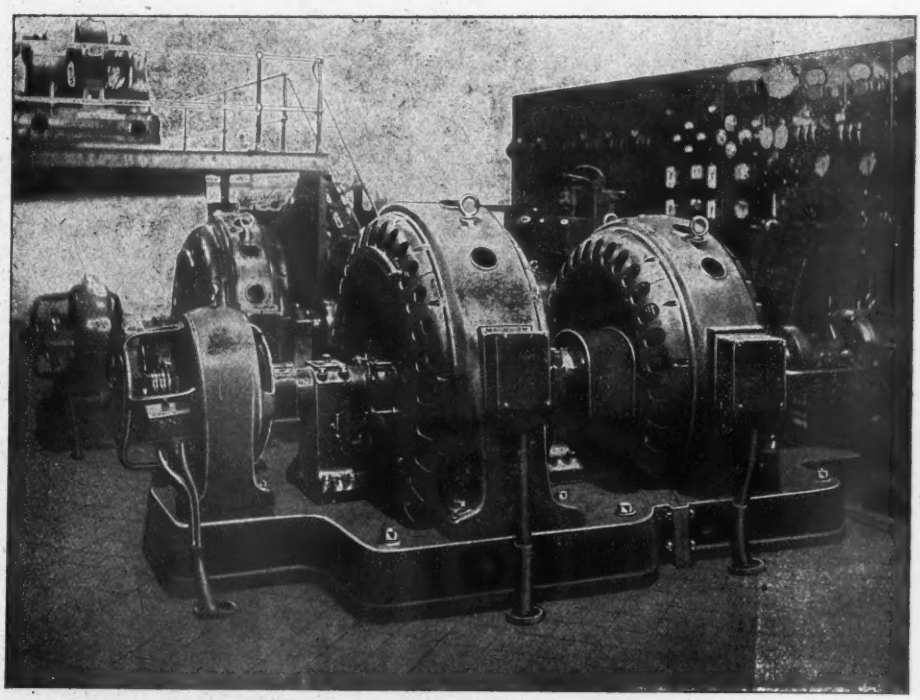
Parsons Turbine Plant, Redditch Electricity Works.

The original undertaking was inaugurated in 1899, and provided a single-phase 70-cycle supply at 2,200 volts to numerous underground transformer sub-stations from which L.T. consumers were supplied.

By March, 1911, the demand for energy for power purposes had outstripped all others, the undertaking selling over 600,000 units for such purposes, as against 173,000 units for private lighting; the need for radical alterations was such that in 1914 Messrs. Handcock & Dykes were instructed to consider and report on the whole matter, and they ultimately recommended the adoption of the three-phase system of supply, with modern turbine plant, and re-arrangement of the underground mains.

This work has now been completed, and the new plant was brought into use in September last. This consists of two 1,000-kw. Parsons turbo-alternators, each capable of carrying 1,500 kw. under overload conditions, which operate on steam at 150 lb. pressure with 150° F. superheat. These sets have a speed of 3,000 r.p.m., and generate three-phase 50-cycle energy at 2,200 volts between phases and neutral, which is earthed, so that any of the original 2,200-volt single-phase feeders can be connected between any phase wire and neutral. All future extensions will be made on the three-phase system, except for very small motors, and it is anticipated that the majority of the existing power consumers will desire to substitute the more efficient and cheaper three-phase motors for their existing plant.

Meantime, in order to give flexibility to the system, two motor alternators of 150 kw. and 300 kw., respectively, have been installed to supply single-phase 70-cycle energy from the three-phase plant, or three-phase energy from the single-phase plant. A new three-phase switchboard has been supplied by Messrs. Bertram Thomas, consisting of 14 operating panels with H.T. gear in stone cubicles behind;



E.C.C. Motor-alternators at Redditch Electricity Works.

a Brown-Boveri automatic pressure regulator has been provided.

To meet the needs of the condensing plant, a new tower capable of dealing with 174,000 gallons of water an hour

has been supplied by the Film Cooling Towers Co.; the old cooling tower will be removed to make room for boiler-house extensions.

Meanwhile, a new 13,000 lb. Babcock & Wilcox boiler has been fixed in a temporary structure at the end of the new portion of the engine house; this is complete with superheater, pumps, &c., and has an independent steel stack and induced-draught plant. In connection with the distribution, the numerous original underground transformer sub-stations have been replaced by five main sub-stations in brick buildings, containing Ferranti oil-cooled transformers, with B.T.H. truck-type H.T. and British Insulated L.T. switchgear; one of the sub-stations is at the generating station, and of the others two are adjacent to factories.

Glover three-phase, four-core H.T. and L.T. cables have been laid throughout the principal parts of the district; these are of the diatrine paper-insulated, lead-covered, steel-armoured type, laid direct in the ground, the work having been carried out by Mr. R. N. Mayne, the Council's electrical engineer, with direct labour. All joints and service boxes have plumbed lead joints enclosed in iron boxes fitted with armour grips.

At the time that Messrs. Handcock and Dykes submitted their report the output for the previous year had been 1,323,876 units, and it is anticipated that with the new plant the output should shortly reach 3,000,000 units, and that under the new conditions a substantial reduction in the cost of production will be made.

SOME NOTES ON THE MEASUREMENT OF THE INSULATION RESISTANCE OF A LIVE THREE-WIRE NETWORK.

By G. W. STUBBINGS.

THE subject of measuring the insulation resistance of live three-wire networks has from time to time received considerable attention, and various tests for this purpose have been proposed. It is, however, probable that at least in the majority of the smaller central stations these tests are not used, owing to the supposed difficulty or inconvenience in making them. In such stations reliance is placed on the readings of the recording ammeter in the earth connection, it frequently being considered that, provided this instrument indicates a reasonably small leakage current, all is well with the network. This state of affairs is greatly to be deplored, for not only is this conclusion entirely fallacious, but proper testing of the network is quite a simple matter, and such tests, periodically taken, form a most valuable guide as to the conditions of the mains.

A few words may be said regarding the readings of the centre zero ammeter in the earth connection. Such readings are purely differential, and, of course, do not enable the insulation resistance of the network to be determined. They are, however, very useful, if, as is customary, the instrument is of the recording type. Small faults can frequently be located by an intelligent inspection of the ammeter chart, if such faults are on consumers' installations. The time that a fault comes on and goes off will sometimes give a useful indication of the class of premises where the fault is to be found. The writer recollects a case of a partial earth being discovered in this way by the recording ammeter indicating a dinner hour that was fixed at a different time from elsewhere. Faults on street lighting circuits can often be traced in the same way. It has been frequently stated that a neutral fault will effectively shunt the earth ammeter, and will cause it permanently to read zero. It should be borne in mind that this is only true when there is an appreciable resistance in the earth connection. When, as is frequently the case, the earthing resistance is short-circuited by a fuse or circuit-breaker, the fault will act as a neutral feeding point, and considerable currents may circulate from the neutral bus-bar through the recording ammeter to the neutral fault. This is the more likely if the neutral fault be on a small distributor remote from a feeding point, where the potential of the distributor may be considerably different from that of the neutral bus-bar. The writer has experienced such a case when the circuit-breaker in the earth connection, which was set at 25 amperes, was repeatedly opened, owing to a dead earth on the neutral of a large consumer's installation. Such occurrences can, of course, be instantly differentiated from faults on an outer by the fact that when the circuit-breaker is opened the potential of the neutral remains at that of earth, and the ammeter reads zero.

The tests that have been proposed for the determination of the insulation resistance of a live network mostly depend upon the alteration of the potential of the neutral by the creation, or the removal, of an artificial fault. The most valuable of these tests is that described by Dr. Alexander Russell, in which the potential of the neutral above or below earth is determined before and after breaking the earth connection. If i be the current through the earthing resistance, and v and v_1 be the potential difference of the neutral and earth before and after breaking the earth connection respectively, then R, the insulation resistance of the network, is given by the formula $R = (v_1 - v)/i$. This can be rewritten $R = v_1/i - r$, where r is the value of the earthing resistance. By the use of an instrument with overlapping pointers, a device has been contrived that enables v_1/i to be read directly, so that by mental subtraction of r, which is, of course, known once for all, the insulation resistance can be determined without calculation. It would seem impossible to improve upon so simple a test. Objections have been raised on account of the necessity of breaking the earth connection. Seeing that this connection need only be broken for a sufficient time to read v_1, this objection does not seem to be so very serious, especially as it is quite simple for the switch in the earth circuit to be held in by a spring, thus obviating any possibility of its being left in the off position. It should also be remembered that there is no possible objection to breaking the earth connection unless this will cause the potential of the neutral to travel away from earth to a considerable amount. If, therefore, v is small, it is improbable that v_1 will be so large as to be dangerous. This point does not seem to have been properly appreciated, for a speaker before the Institution of Electrical Engineers, some years ago, dealing with this matter, objected to Russell's test, on the ground of the undesirability of breaking the earth connection, and then went on to describe an additional test, in which the potential of the neutral was moved 200 volts from that of earth. There is, of course, the possibility of a dead earth occurring during the few seconds that the earth switch is out, when, if the neutral be sound, the potential of the other outer will rise to double the normal voltage from earth. This possibility is not great, certainly not great enough to vitiate the usefulness of this important test.

As the insulation resistance of the network can be calculated from observations of the results of any alteration of the value of an artificial fault, it is not difficult to devise other tests in which the opening of the switch in the earth circuit is not necessary. One such test is Raphael's. In this test, it will be remembered, the ammeter with the resistance in series is shunted with a resistance of exactly equal value. If d_1 and d_2 be the readings of the ammeter, or of any instrument giving deflections proportional to the current, before and after shunting, R the insulation resistance of the network is given by $R = r\,(d_1 - d_2)/(2\,d_2 - d_1)$, r being the value of the resistance and ammeter in series. This test, besides other limitations, suffers from the disadvantage of requiring an additional resistance. Another test was suggested by Mr. Taylor in a paper read before the Institution of Electrical Engineers in 1903, in which the voltage difference between the neutral and earth is brought to zero by an adjustable artificial fault on an outer main, when R is given by $R = v/(i_1 - i)$, i_1 being the current in the artificial outer fault, and v and i having the same values as before; this test, like Raphael's, requires additional apparatus, in this case in the shape of an adjustable resistance of some size, the provision of which might involve some expense.

A simple test, which to the writer's knowledge has not been before suggested, can be employed when a moderate resistance is normally short-circuited by a fuse or circuit-

breaker. In this test the current in the earth connection is observed with the resistance short-circuited, and, again, with the circuit-breaker or fuse opened. Calling these currents i_1 and i respectively, and the potential of the neutral with the circuit-breaker open v, the insulation resistance of the network is given by $R = v/(i_1 - i)$. The arrangement is shown in the diagram, fig. 1, and the proof is simple.

Let the voltage between the outers and neutral be E, and the fault conductivities of the positive, negative, and neutral mains be respectively c_1, c_2, and c_0; we have, the circuit-breaker being closed,

$$c_1 E - c_2 E = i_1.$$

With the circuit-breaker open we have :—

$$c_1 (E - v) - c_0 v - c_2 (E + v) = i.$$

Subtracting the second of these equations from the first, $v (c_1 + c_2 + c_0) = i_1 - i = v C$, C being the combined conductivity of the three mains. We therefore obtain—

$$R = v/(i_1 - i).$$

This test is almost as simple as Russell's, but is not open to the objection which applies to this latter test. If conditions be such that the reading of the earth ammeter is very small with the circuit-breaker closed, an artificial fault of known resistance can be put on one of the outers to increase this reading. The insulation resistance, as calculated, will, of course, include this resistance, and must, therefore, be corrected accordingly.

The combined insulation resistance of the network, as found by any of these tests, is of limited value by reason of the fact that the separate insulations of the three mains are still unknown. The problem of obtaining these separate values is one of considerably greater difficulty than that of finding the combined value. It is obvious that it is impossible to solve the problem by the use of artificial faults, and consequently other means must be found. Of the three insulation resistances it is, perhaps, most desirable to know that of the neutral, as a serious diminution in the insulation resistance of either of the outers is usually indicated by the recording ammeter in the earth connection, simultaneous faults on the two outers being of rare occurrence. An approximate method of obtaining the insulation resistance of the neutral can easily be contrived on the assumption that the insulation resist-

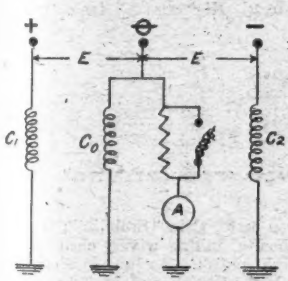


Fig. 1.

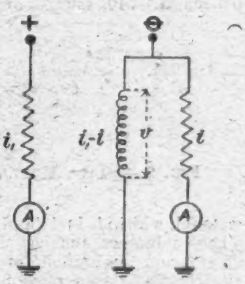


Fig. 2.

ances of the outers are so high that the positive and negative leaks are negligible. By causing the potential of the neutral to travel away from earth by an artificial leak on an outer, it is possible by measuring the current in the leak and the current returning through the earthing resistance to obtain the current returning through the neutral faults. The arrangement is shown in the diagram, fig. 2.

If i_1 be the current in the leak, i that in the resistance, and v the potential of the neutral, we have $i_1 - i$ as the current in the neutral leaks. The insulation resistance of the neutral is accordingly $r_0 = v/(i_1 - i)$. As before stated, this result is only accurate if the insulation resistances of the outers are very high compared with that of the neutral. If, therefore, this method gives a satisfactory value of the neutral insulation, the actual insulation resistance will be slightly higher.

In order to obtain accurate values of the separate insulation resistances of the three mains, it is necessary to introduce another alteration to the existing conditions, and it has been suggested by Dr. Gisbert Kapp and Dr. Dennis Coales, in a communication published in the *Journal* of the Institution of Electrical Engineers in 1909, that this can be done by altering the voltage across each side of the system. The method depends upon raising, first, the voltage on the positive side, and then the voltage on the negative side, the voltage across the outers meanwhile being maintained constant. The alteration in the potential of the neutral from earth with a moderately high resistance in the earth circuit is obtained, and from the observed data the insulation resistances of the three mains can be calculated. The method can be readily adapted so that it is not necessary to open the circuit-breaker in the earth connection, if means are employed for determining with fair accuracy the alteration in the current in the earth connection. If the normal voltage across each side of the system be E, and this be increased on the positive side by an amount e, which will, of course, not be sufficient to exceed the deviations in voltage allowed by authority, the voltage on the negative will be diminished by a similar amount. These voltages will now be respectively $(E + e)$ and $(E - e)$. Let the current in the earth connection, the short-circuiting circuit-breaker being in, be i_1. The positive voltage is now diminished, and the negative raised, to assume values of $(E - e)$ and $(E + e)$ respectively, when the current in the earth connection will be i_2. These conditions can be represented by the following equations, c_1, c_2, c_0, having the same values as before :—

$$c_1 (E + e) - c_2 (E - e) = i_1.$$

$$c_1 (E - e) - c_2 (E + e) = i_2.$$

Subtracting $2e (c_1 + c_2) = i_1 - i_2$.

$c_1 + c_2 = (i_1 - i_2)/2e$, and $c_0 = C - (i_1 - i_2)/2e$, C being the combined conductivities of the three mains as found by Russell's or some other test.

If conditions are such that the current in the earth connection is very small, an artificial leak can be introduced to give good readings, and if this same leak be used to determine R or C its value need not be known, as it will be included in the value of $c_1 + c_2$ as found in the second test, and also in the value of C, and its effect will therefore be eliminated. This test will, of course, fail if the fault on the neutral is so great as to cause currents to circulate between it and the neutral bus-bar; but as has been before pointed out, this state of affairs can be detected at once by opening the circuit-breaker in the earth connection, when the potential of the neutral will not alter; this being the case, a bad neutral fault will be indicated, and quantitative measurements will be quite superfluous. The test may otherwise be of some value, as it is not difficult to carry out, the alterations to the voltage across the outers being easily made by the switchboard attendant.

It has been suggested to measure the insulation resistance of the neutral by drawing away its potential from earth by an artificial fault, and by observing the increase in the currents in the neutral feeders. This method is of doubtful use unless the insulation of the neutral be very low; as, in order to get observable alterations on the neutral feeder ammeters, it will be necessary to subject the neutral to an undesirable potential from earth, and thus reproduce, in a worse form, the disadvantage of Russell's test. If the neutral insulation be very low the test suggested earlier in this article will be of greater service. The method of observing the alterations in the current in neutral feeders is invaluable in locating a neutral fault, as, in these circumstances, a considerable artificial leak will not greatly alter the potential of the neutral, and considerable currents can be caused to flow through the fault. By testing and transferring, a neutral fault can by this means be localised to as small a section as may be desired.

It is hoped that the above notes will assist to dispel the popular idea that insulation tests on a live network are complicated or difficult. By the use of an instrument with overlapping pointers mounted on a panel with suitable switchgear, Russell's test becomes one of the extremest simplicity, and can be performed periodically by so comparatively unskilled a person as a switchboard attendant. If the breaking of the earth connection be considered undesirable, Raphael's test, or the one suggested by the writer, can be employed, the latter requiring no special apparatus

and a very simple calculation. It is, of course, impossible to anticipate or prevent all faults by periodical testing, as it is well known to mains engineers that a distributor section that tests approximately perfect to-day may go down to-morrow, while another section may show a low test and last for years. Nevertheless, apart from mechanical damage and accidental causes, such as the flooding of a disconnecting box, faults, as a rule, take some time to develop; and it therefore follows that an incipient fault should be indicated by a lowering of the insulation resistance of the network. These remarks apply especially to the neutral of the system, for as in this case the conductor is but rarely very much removed from earth potential, an incipient fault will take longer to develop, but will possibly break down instantly if subjected to full voltage by a dead earth on an outer. It is therefore desirable frequently to check the insulation of the neutral, to avert the possibility of a dead earth causing a shut-down. The neutral test described by Dr. Kapp and Dr. Coales, already referred to, or the adaptation of this test suggested by the writer, may be of use in this connection.

In conclusion, it may be of interest to refer to a remark made by Dr. Sumpner, speaking before the Institution of Electrical Engineers, in 1904, on the subject of network testing. It was pointed out that Russell's test depends upon a simple principle stated by a French scientist over 30 years ago. This principle may be stated as follows: If in any complicated system of resistances and E.M.F.'s two points are joined by an adjustable resistance, by observing simultaneous values of the current in this resistance, and the voltage across it, the resistance of the system between the two points in question can, by Ohm's law, be calculated by dividing the alteration in voltage by the alteration in the current. This most interesting point does not seem to have received the attention that it deserves. The formulas for Russell's and Raphael's tests can be immediately deduced from it. In each case i and v, i_1 and v_1, being simultaneous values of the current in the earth connection and the potential of the neutral respectively, the insulation resistance R will be given by $R = (v_1 - v)/(i - i_1)$.

In Russell's test—$i_1 = 0$ and $R = (v_1 - v)/i$.

In Raphael's test—$v_1 = K r d_1$, and $v = K r d_2$

$$i = 2 K r d_2, \text{ and } i_1 = K d_1$$

$$R = r (d_1 - d_2)/(2 d_2 - d_1).$$

In the test suggested by the writer—$v = 0$, $R = v_1/(i_1 - i)$.

These results are so simple, compared with the rather cumbersome algebraical expressions usually employed to establish the formulas, as to be worthy of notice.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

Earth Detector for Transmission Lines.

In order that operators may be warned of any grounds on the 1,200 miles of 2,200-volt lines of the Southern California Edison Co. as soon as they develop, Mr. G. E. Armstrong has devised an earth detector, which is more sensitive than the static type, and in addition gives an audible as well as a visible signal. The outfit includes three Y-connected 2,200/122-volt transformers, across the secondaries of which are connected carbon lamps, arranged symmetrically inside a cylindrical case with a ground-glass front, and separated by partitions. Between the primary, neutral, and earth is connected a high-resistance telegraph relay, with an alarm bell.

When a "ground" occurs on any one of the lines the potential across the transformer connected to that phase will be reduced and the potential of the remaining transformers slightly increased. Coincidently, current will flow from the neutral to ground, and the lamp which is connected across the grounded phase will be dimmed or extinguished, depending on the resistance of the ground, and the other lamps will increase in intensity. At the same time the current flowing from neutral to ground through the telegraph relay will ring the alarm bell. The relay is so connected, however, that its coils are automatically short-circuited directly after transmitting the signal, to protect them against excessive voltages which might occur.

With this equipment "grounds" having as high a resistance as 500,000 ohms can be detected visually by comparing the lamp intensities. Much higher resistance grounds than can be indicated by the lamps can be detected audibly by the alarm bell operating. Extremely poor grounds, such as a wire lying on dry and painted cement inside a station, have even been detected by the device.

"Hightensite," a New Insulating Material.

One of the conditions exerting a controlling influence in the electrical engineering industries, the existence of which was revealed to us by the war, was the fact that the manufacture of certain essential classes of insulating materials was an almost absolute monopoly in German hands. We refer especially to

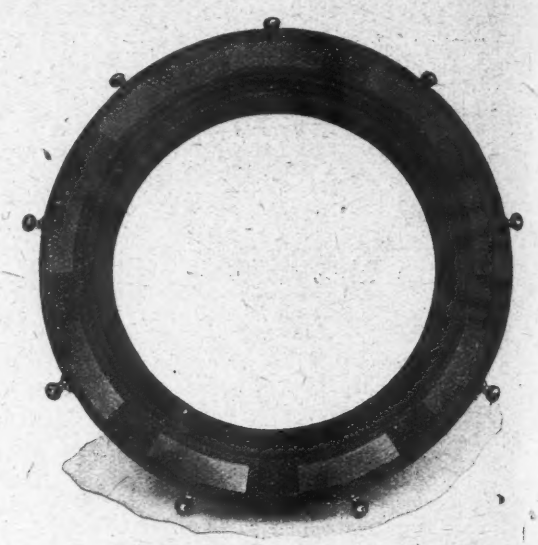


Fig. 1.—"Hightensite" Distributor.

moulded compositions, of which "Stabilit" was the most important, as was exemplified in the legal proceedings recently reported in our pages, this being *par excellence* the most suitable material for use in the manufacture of magnetos and similar apparatus requiring the highest insulation. Fortunately, in this connection, as in so many other industries, the skill and ingenuity of British manufacturers have not been found wanting. Compelled to find substitutes for the formerly imported materials, they have completely retrieved the situation. We have just received from the Park Royal Engineering Works, Ltd., of Cumberland Avenue, London, N.W. 10, samples of their new "Hightensite" insulating

Fig. 2.—Small Moulded Parts of "Hightensite."

material, which, it is claimed, is even better than "Stabilit"; it is a hard substance, tougher than ebonite, taking a very clean-cut thread and susceptible of a high polish. As an insulator, Hightensite takes a place in the highest rank, and its dielectric strength, as determined by the National Physical Laboratory, is over 20,000 volts per millimetre; it is also non-inflammable and non-hygroscopic, but is not suitable for use in contact with oil, owing to rubber being one of its constituents.

Hightensite is made in the form of rods and sheets, but its chief uses appear to lie in the direction of moulded parts, with or without metal fittings embedded in them. We have before us a 9-point distributor for a rotary engine, and must express our admiration for the beauty of the fitting as a work of art, apart from its electrical and mechanical properties. We are informed that over 100,000 parts are now in hand for various Government orders. The accompanying illustrations show the distributor above mentioned, and a variety of small parts for magnetos and similar applications.

Electrical Exhaust Fans.

Messrs. S. G. Leach & Co., Ltd., of 26-30, Artillery Lane, E.C., recently issued a new exhaust fan list, LF 7, one of a series of eight fan lists.

The fans are fitted with the ordinary box blade or the more efficient patented Beedle blade—the latter in the 2, 3 and 4-way types, the 2-way being most efficient on free intake and discharge, whilst the 3 and 4-way types are more suitable for working against resistance.

The fans are motor or belt-driven; in the former case direct-current series motors of the totally-enclosed or semi-enclosed pattern are fitted, starters with automatic features being recommended for D.C. fans above 24 in. size, and if above 240 volts working pressure, and for all sizes for higher pressures.

Induction type short-circuited rotor A.C. motors are also fitted, for single or polyphase working; 12-in. to 18-in. diameter fans can be made for use on 25 to 133-cycle supply; fans from 24 in. to 36 in. for 25 to 83-cycle supply, and larger sizes for any frequency from 25 to 60 cycles.

The smaller fans are grease lubricated, and in A.C. and larger size D.C. fans ring oilers are provided. All parts of the fan and

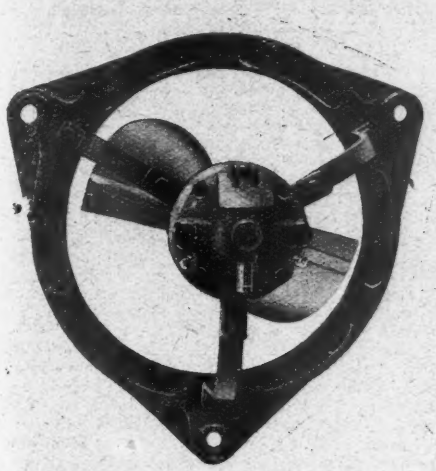


FIG. 3.—TWO-WAY D.C. BEEDLE-BLADE FAN.

motor are interchangeable, so that replacements can be quickly and cheaply made.

We illustrate in fig. 3 a 2-way Beedle-blade fan with D.C. motor, and in fig. 4 a box-blade fan with A.C. motor.

It may be of some interest to quote from the tabulated data contained in the list, that a 2-way Beedle-blade D.C. fan, 24 in. size, at 600 R.P.M., gives 4,800 cb. ft. per min. air discharge on 120 watts, while a 24-in. A.C. box-blade fan at 560 R.P.M. gives 3,500 cb. ft. per

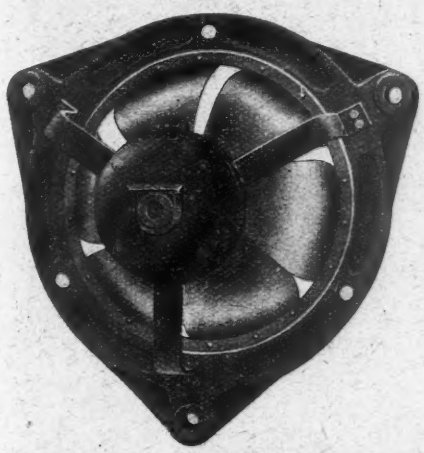


FIG. 4.—A.C. BOX-BLADE FAN.

min. air discharge on 165 watts, the figures referring to free intake and discharge.

A series of curves shows the more efficient results obtained with the Beedle-blade type of fan, but experience indicates the necessity of knowing the exact conditions of working in order to obtain the best results.

Messrs. Leach & Co. specialise in fan work, and supply the usual accessories, such as regulating resistances, starters, louvre and butterfly shutters, &c.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Static Sub-stations.

With regard to your contributor's article on "Static Sub-stations," an arbitrary comparison of the number of sub-stations in two areas of supply, without reference to pressure, system (two or three-wire), or the age of the undertaking, is, unfortunately, a counsel of perfection only having an academic interest for a great many districts. How many engineers, in charge of undertakings, considered in their day the *dernier cri* in electric supply, do not dream of the unattainable ideals indicated by your contributor? How many, in thinking of their systems, would not "shatter them to bits and then remould them nearer to the heart's desire," if the barrier of finance did not intervene?

Mains Engineer.

June 2nd, 1917.

Trade After the War.

With reference to the article and correspondence on the above subject which has appeared in your paper lately, I send herewith a cutting from the *Lyttelton Times* of March 28th, which has some bearing on the subject, and may be of interest at the present time.

Comment is hardly necessary, as the results of the proposal are obvious. The men on their return from America will naturally recommend the apparatus which they are used to, which will be American. If British goods are to have a big field here, some form of advertising and popularising British manufactures must be begun.

The training of engineers in England in the manner offered by the American Commercial Attaché to Australasia would seem to be an exceedingly practical scheme, which merits consideration.

A.M.I.E.E.

New Zealand.

From the *Lyttelton Times*, N.Z.

Before the Chamber of Manufactures, at Melbourne, a few days ago, Prof. Kennedy, American Commercial Attaché to Australasia, delivered a very interesting lecture on the advantages of modern methods in business and the possibility of closer co-operation between manufacturing Australia and her big brother, manufacturing America. . . . . The lecturer explained the methods of training adopted by large companies in America, such as the Westinghouse Co. and the General Electric Co., who specialised among their apprentices and themselves reared their own skilled mechanics, foremen, and high technical men. He stressed the value of specialisation and factory organisation as aids to industrial success, and predicted an industrial renaissance in England after the war. On behalf of the American Bureau of Domestic and Foreign Manufactures, he was empowered to offer to train Australian apprentices in America, so that they could bring back to Australia the best and latest in the American industrial world. The chief qualification was that the applicants should be graduates of technical schools. Other desirable qualifications were quickness of observation, earnestness, grit, good health, democratic ability to get along with men, and ambition. The apprentice who did not possess these qualifications would be unlikely to complete his course. A living wage of $50 to $75 (£10 to £15) a month would be paid during apprenticeship.

[In this connection, we may draw attention to the excellent scheme devised by Mr. Harper, city electrical engineer, Melbourne, which was described in our issue of April 20th, 1917.—EDS. ELEC. REV.]

"Business as Usual"?

I beg to enclose you an advertisement cut out of a paper, and as, at the present time, most of us who have in the past done any considerable amount of business are in the condition that almost the only thing we are looking forward to is to preserve business connections, it seems rather odd that anybody should be in a position actually to want trade in this manner; it is more particularly pointed when I notice in the same issue that a firm at Huddersfield have a running advertisement for 20 wiremen for Government work. I am quite sure that most firms with the few men they have left have more than enough to do to keep their old customers running without wanting to take any new work on, and if this optimistic gentleman who advertises has such a superfluous staff, I think I could recommend the attention of the Tribunals or the Ministry of Munitions to him. It will be interesting to know where the new buildings are going up, unless these are Government factories.

Contractor.

June 2nd, 1917.

[COPY.]

ELECTRICAL Installation Contractor requires correspondents in various towns to report upon likely business openings; liberal remuneration. Manufacturers' and Builders' Agents, and others conversant with building and electrical developments, communicate with H419, Evening Post, Leeds.

National Insurance (Unemployment) Acts, 1911 to 1916.

—Contributions are payable in respect of :—

2,270 X.—Workmen employed in the gas department of a City Council, and engaged in drilling holes in gas lamp pillars, or in painting lamps in a workshop.

WAR ITEMS.

Municipal Employés for Military Service.—The Glasgow T.C.'s Special Committee recommends that 24 employés in the service of the Glasgow electricity department, and 71 additional employés, provided suitable substitutes are found for them, be released for service with the Colours.

Exemption Applications.—The Military appealed to the East Sussex Tribunal against exemption until August 9th granted to two electrical fitters (41 and 30, and passed for general service), and to July 9th allowed to the manager (33, B 1), engaged with a Brighton firm of electrical engineers. The men are engaged in much work at hospitals, and the firm pleaded a depleted staff, 25 of the staff of 35 being boys and women, the skilled men left numbering only five. In the case of the fitter aged 30, the exemption was made final; in the other two cases the exemption was confirmed.

At Bexley, a review was made of conditional exemption held by R. Puffitt (35) and T. Grady (37), both in Class A, motormen on the U.D.C. tramways. The Military Representative said that such men were required for transport service. Mr. Harris said that the men came on the staff at a very critical time, when others went into the Army. The Tribunal respited the appeal until six other cases were gone into. The Tribunal also dealt with the cases of A. R. Williams (40, B1), engineer and tram depôt superintendent; A. H. Duly (29), stoker-driver; C. E. Higgs (41), engine fitter, &c.; and W. E. Wicks (21, C 3)) mains assistant; all of whom had been de-badged. The case of Wicks, who is medically unfit, was adjourned until he is called up; in the other cases three months' exemption was conceded.

At Oxford, the Electric Light Co. asked for three months' exemption for W. C. Coates (27), shift stoker, but the appeal was refused. The company also appealed for F. R. Stevens (27), engine fitter, and H. J. Brooks (31), shift stoker, and the Military appealed against three months' exemption granted to S. J. Wright (33), switchman. It was stated that the cases had been dealt with as between the dilution officer and the military representative, and the latter agreed to the cases being dismissed in view of exemption granted by a Government department.

At Winchester, the Military appealed against conditional exemption held by a shift engineer, aged 19, in Class A, on the staff at the Corporation electric light works. The manager, Mr. Ayton, said that of 26 men employed at the works, 17 were of military age, one being unfit owing to his having a short leg. The man appealed against was previously on the clerical staff, but he came originally with the idea of taking up electrical engineering, and he took over the work of a shift engineer in August, 1915. An effort was being made to get a girl substitute. The works were kept running for 24 hours in eight-hour shifts, and if he lost one of his shift engineers the others would have to work in two shifts of 12 hours each. They had lost 17 men from the works, and their places had been taken by men not of military age, boys, and girls. The appeal was allowed and the exemption cancelled, with one month's grace.

Before the Essex Tribunal, the military appealed against conditional exemption held by H. T. Baker (37, C 1), who is engaged as an engineer at the Ilford tramway depôt. It was urged that it was very important that the trams should be kept running, because there were so many munition workers in the district. The appeal was disallowed, and the exemption continued.

Folkestone Tribunal has, on a review, confirmed conditional exemption held by W. R. Varney (39), electrician at the Electric Theatre.

Worcester Tribunal has given exemption until September 30th to W. Tetstall (21), electrician. He is the only man left in the business of Mr. C. E. Abell, who is a lieutenant in the Army.

Mr. J. M. Joseph (26, C 3), dealer in electrical fittings, of Leyton, has been given exemption until the end of September.

Mr. W. H. Meredith (35), electrical engineer, Lye, was appealed against by the military, he having been given three months' exemption by the Local Tribunal on the ground that he is in a certified trade. The appeal was allowed.

At Denton, Manchester, a number of appeals by the Military Representative against exemption granted to tramway employés were heard. The Military Representative asked that men classified as A or B 1 should have their certificates cancelled, but not to be called up until substitutes were provided, and until Mr. Anderson, the manager of the Oldham, Ashton & Hyde Electric Tramways Co. was satisfied that the substitutes were acting satisfactorily. The Tramway Co. opposed the application, and on their behalf it was pointed out that it was an important and necessary undertaking, and that it had already lost as many men as could be spared. Fifty-two employés, including mechanics and electricians, had gone into the Army. Twelve motormen had their certificates varied, the Chairman saying they would be put in reserved occupations so long as they continued as motor drivers, or until a competent substitute was provided by the military authorities.

G. Dring, station foreman of the Ilfracombe Electric Light and Power Co., Ltd., was, on May 31st, granted by the Ilfracombe Tribunal a further extension to October, when the case will again come forward. Mr. H. Stewart, the resident engineer, appeared for the company. The case was not pressed by the military authorities.

LEGAL.

AN IRISH ELECTRICAL ASSESSMENT.

THE Lord Chief Justice of Ireland, sitting in the Appeal Court, Dublin, agreed that the hearing should be taken up as early as possible of the case of the Clones Electric Light and Power Co., appellants, and the Commissioner of Valuation, respondent, which, it was explained by counsel, raises an important point of valuation law. The matter arises on a case stated by County Court Judge Johnston, at the request of the Valuation Commissioner, who is dissatisfied with a decision of the Judge at Monaghan.

The plaintiff company appealed against an order imposing a revised valuation of £100 (which included £20 upon the appellants' power station), assessed upon the undertaking. The first valuation had been £75 and £25 respectively, making an aggregate of £100. Appellants submitted that the revised valuation was excessive. The County Court Judge reduced the valuation to £75, apportioning £25 to the buildings, &c., and engines therein, and £50 to the mains, poles and easements. The questions for the High Court of Appeal are:—(*a*) Assuming it to be a question of law, not of fact, was the County Court Judge right in holding that the accumulators, dynamos, switchboard and shafting and electrical instruments were not machinery for the production of motive power? and (*b*) was the County Court Judge right in eliminating the present value of the machinery from the calculation as to the "landlord's allowances," and treating that value as part of the tenant's capital in respect of which "tenants' allowances" should be made?

The LORD CHIEF JUSTICE said an important point of principle was involved, and the Court would like to have it fully argued on a day, or days, suitable to all parties.

DUNDALK ELECTRIC LIGHTING LOANS.

IN the Chancery Division of the High Court of Justice in Ireland, before Mr. Justice Barton, on Friday last, the Dundalk Urban Council's application in respect of electric lighting capital came on for hearing, the defendant being the Attorney-General for Ireland.

Plaintiffs sought a declaration that under the Public Health Act and the Electric Lighting Acts the Local Government Board were entitled, if they thought fit, to grant a loan to provide working capital or working balance to enable their electric lighting undertaking to be carried on, wages to be paid, and other expenses to be met until revenue could be collected. The Council had entered into a contract to supply current for power and lighting to the Great Northern Railway of Ireland for their works at Dundalk, and for that purpose had ordered two Diesel engines; but, owing to the war, the delivery of the engines had been delayed, and the Council had been unable for one year to carry out their contract with the railway company, thus causing a loss of £1,800 in revenue. Owing to this situation the estimated revenue had been depleted, and the Council applied to the Local Government Board for sanction for a loan of £2,000, but they replied that they had no power to sanction such a loan, as it was only for permanent works, and not for working capital, that a loan could be granted. They granted £3,000 for additional plant required.

MR. DICKIE, K.C., for the Council, opening the arguments, cited several cases to establish the right to seek the opinion of the Court on the point of law, notwithstanding the decision of the Local Government Board. He entered at large into the question of the meaning of the term "capital," urging that working capital was as necessary as the capital cost of plant, since, he said, there was no use providing plant unless the Council had the funds to pay for it, and the Council had no authority to strike a rate for this purpose, though they could, at the end of the year, strike a rate for any deficiency.

MR. T. F. MCGAHON, chairman of the Council, furnished details of the capital expenditure on plant. The Council in the first year, to provide working capital, advanced, he said, £580, and later they permitted the electricity department to retain a large share of its income in order to finance the working, with the result that the department remained in debt to the Council on account of interest and sinking fund. This was felt to be an unsatisfactory arrangement, and the Council wished authority to overdraw the bank account of the electricity undertaking for the purpose of, from time to time, paying wages and running expenses, as would be done in like circumstances by any commercial concern, instead of having the concern in debt to the Council.

In cross-examination, MR. MCGAHON said that, owing to the delay in getting the railway company's contract under way, the Council had been involved in heavy capital charges, and their application to the Local Government Board Inspector was alternatively for leave to re-borrow the amount thus paid while the railway scheme was non-productive, or for a loan for working capital.

MR. SPALDING, electrical engineer, detailed the arrangement for supplying working capital to the undertaking.

For the Attorney-General, MR. WYLIE, K.C., held that under the Public Health Act, which was the foundation of the Council's borrowing powers, money could only be borrowed for permanent works.—The further hearing was adjourned until this week.

SOME PATENT AND TRADE MARK CASES.

[FROM A LEGAL CONTRIBUTOR.]

THOSE who write in the papers about the law's delays and seek to explain the slowness of the legal machine, sometimes attach a portion of the blame to patent and trade mark cases. While it is true that enquiries as to the rights of patentees do occupy a considerable portion of judicial time, the general public knows very little about them. When a breach of promise case is in the list the reporters flock to that particular court, and take note of everything that occurs. On the other hand, when a patent case is called on for hearing, the reporters box is vacated almost at once.

In these circumstances the public have little opportunity of studying the details of this class of case except through the columns of the technical press, and even a technical paper must needs exercise a certain amount of discrimination. For instance, it is not every patent case that would interest the electrical engineer. The invention of a new kind of safety pin might concern his amiable lady, but a case concerning it would not be likely to involve any principle which really affected him in his business.

In the following paragraphs will be found collected together a few recent patent, trade mark, and passing-off cases which appear to be of general interest to readers of the ELECTRICAL REVIEW.

Amongst patent cases, those which have to do with failure to work the patent in this country have naturally taken a somewhat prominent position.

In R. Ward's patent (33 R.P.C. 408) an application was made under Section 27 of the Patents and Designs Act, 1907, to revoke a patent granted to Wardwell for "Improvements in or relating to winding machines for yarn threads, tapes, and the like" on the ground that the patented article was manufactured exclusively or mainly outside the United Kingdom. It was contended on behalf of the patentee that there was no manufacture of the patented article either in the United Kingdom or elsewhere, inasmuch as the machine which was admittedly manufactured outside the United Kingdom did not come within all the claims of specification, and that consequently the section did not apply. Alternatively, it was contended that the machine comprised many castings which could only be obtained satisfactorily in the United States. It was held by the Comptroller-General that the machine manufactured in the United States embodied the patentee's invention, or at any rate, an important part of it; that it was covered by many of the more important claims, and must therefore be considered as a "patented article." Further, the reasons given for non-manufacture in the United Kingdom were not satisfactory. He, therefore, decided to revoke the patent, but suspended the making of the order for one month to allow the patentee an opportunity of applying to amend his specification by striking out such parts as admittedly embodied the patented article which was manufactured in the United Sates and not in this country. The applicant was awarded 35 guineas costs.

In another recent case, an attempt was made by a patentee to secure a prolongation of the term of his patent. It never was easy to obtain an extension of time; and this case affords a favourable example of the difficulty there is in persuading the court to allow a patentee to enjoy his monopoly for a longer period than 14 years.

In 1899 a patent was granted for a "method of and apparatus for effecting the storing up of speech or signals by magnetically influencing magnetisable bodies." One of the claims was for: "The herein described method of receiving, storing and reproducing messages, signals, or the like, by subjecting a magnetisable body, such as steel wire or strip, to the action of an electro-magnet which moves along it, or along which it is moved, the coil of this magnet being first in connection with a transmitter, so that the wire or strip is influenced in a manner corresponding to the signals transmitted, and the coil being then in connection with a telephone receiver by which the signals which influenced the wire or strip are reproduced." A petition for the extension of the patent was presented by the assignees of the patent, an American company, which was not a manufacturing, but only a promoting, company. The bulk of that company's stock was held by a Danish company, which itself was not a manufacturing company, the manufacturing in Denmark being done by another Danish company. No attempt has been made to work the patent in the United Kingdom, beyond an endeavour to form a company for the purpose. The invention was of great scientific merit, and apparatus made in accordance with it gave good results, but, although many attempts had been made to produce a commercially useful apparatus, no success had been achieved before the date of the presentation of the petition. The petition did not state the fact that the patentee, with an associate, had received £10,000 from the sale of shares in one of the foreign companies; it stated that the great defect in the machines had been their difficulty of adjustment and their fragility, but the patentee in his evidence stated that a machine exhibited did not suffer from fragility. It was held that the petitioners had not shown that the merits of the invention were such as, in the interests of the public, would justify the extension of the term of the patent, and that they had not explained or attempted to explain or justify their not having attempted to put the invention into use in this country; also that if an extension were granted the benefit of it would belong directly to the petitioners (who had not done anything to develop the invention), and indirectly to the Danish company, and still more indirectly to the patentee; and that the petitioners were wanting in the required *uberrima fides*, in that they had not stated in their petition the patentee's profit, and had stated that the machines suffered from fragility. The petition was dismissed.

It is often convenient for a patentee who has attached a trade mark to his patented article to limit the use of that trade mark to the top of the patented article, especially in a case where he grants a licence to use the patent. The validity of this practice was discussed in the *Bowden Wire Ltd. v. Bowden Brake Co., Ltd.* The plaintiff company, who were the proprietors of the patent for the well-known "Bowden Wire" used in connection with the transmission of power for cycle and motor-cycle brakes, in 1901 promoted the defendant company, and transferred to it that part of their business which was concerned with brakes for pedal cycles only. In 1903 the plaintiff company registered a trade mark for brakes for velocipedes consisting of a picture of a coil of wire with the word "Bowden" enclosed therein, and they granted a licence to the defendant company to use this mark in connection with the brakes for pedal cycles. The licence was limited to the continuance of the letters patent. In 1904 the plaintiff company registered the same trade mark in respect of certain other goods in Class 13. The directors of the two companies were substantially the same until shortly before the commencement of the action. On the expiration of the patent, the defendant company continued to use the mark, not only on brakes for pedal cycles but also in respect of brakes for motor-cycles, which they then began to manufacture. The plaintiff company brought an action to restrain the defendant company from using the trade marks on any goods manufactured by them. The defendant company contended that the licence was ineffective, and that the mark had been used by them for a great number of years, not only with the knowledge but also with the concurrence of the plaintiff company. The defendant company moved to expunge the trade marks, and alleged that they were not distinctive, and that they were calculated to deceive.

It was held that the defendant company had no general right to continue to use the trade mark after the term of the licence had expired, and no right to prevent the plaintiff company from continuing to use the mark in the same manner as they had used it since the registration. It was also held that the trade marks were distinctive and not deceptive, but that on the ground of non-user, an order should be made under Section 35 (1) of the Trade Marks Act, 1905, varying the entry of the first-mentioned trade mark by restricting it to brakes for road vehicles other than velocipedes or cycles wholly propelled by the physical force of the rider. No costs of the motion were given except that the applicants were ordered to pay the registrar's costs. In the action an injunction against infringement of the trade marks, limited in accordance with the above-mentioned restriction, was granted with costs.

While dealing with patent and trade mark cases, it may be convenient to say a few words about passing-off actions. A trader frequently owns that which is better than any patent or trade mark, namely, a good name, in the use of which he is protected by the courts. A recent case may be cited in this connection in order to show in what circumstances the courts will interfere.

It was laid down many years ago that a man will not generally be restrained from using his own name in connection with goods made or manufactured by him, unless it is clearly shown that he has intended to deceive the public. The principle was re-affirmed in a case relating to pianos. It appeared that John Brinsmead & Sons, Ltd., the well-known pianoforte makers, brought an action against Edward George Stanley Brinsmead, a pianoforte manufacturer, and Waddington & Sons, Ltd., pianoforte dealers, to restrain them from passing off pianos made by Stanley Brinsmead as and for the pianos of the plaintiff company, and they also charged the defendants with conspiring together to so pass off the pianos. The plaintiff company put on the fall of their pianos the words "John Brinsmead & Sons, London," in capital Roman letters surrounded by lines. On the fall of the pianos made by the defendant there appeared in a running hand the name "Stanley Brinsmead," with a broad dash at the foot of the "d" coming back under the whole of the name, and the word "London" in printed Roman characters underneath. In the curls of the initial "S" in small letters were placed the names "Edward" and "George." The evidence showed that a "Brinsmead piano" meant to the trade and to the public a piano made by the plaintiff company, and that the christian name used by the plaintiff company and those of the defendant company were not generally known. It also appeared that the defendants' pianos were cheap instruments, and had a sale amongst a different class of people from that to which the plaintiff's company's new pianos were sold. The defendants, Waddington and Sons, Ltd., previously to and at the trial, offered to submit to an injunction restraining them from passing-off, if the charge of conspiracy were withdrawn, which offer was not accepted by the plaintiff company. The evidence against Waddington & Sons, Ltd., showed that they had advertised pianos of the defendant Brinsmead as "Brinsmead" by itself, and had represented to customers that one of such pianos was a "Brinsmead" piano. It was held: (1) That the

defendant Brinsmead had put his name Stanley on his pianos as prominently as the word "Brinsmead," and had not attempted to imitate the mode in which the plaintiff company's name was used, and that he had not acted dishonestly, notwithstanding that he knew that he was deriving some advantage from the fact that his name was the same as that of a well-known manufacturer; (2) that the charge of conspiracy failed. The action against him was dismissed with costs. Waddington & Sons, Ltd., having submitted to an injunction restraining from passing-off, an order was made against them with the costs of the plaintiff company up to the date of the first offer, except so far as the costs had been increased by the charge of conspiracy, but the plaintiff company was ordered to pay the increased costs and the costs from the date of the offer.

The second case involved an attempt to acquire a monopoly by claiming an exclusive right to the title of a magazine, but it was not always successful. In *Stevens v. Cassell and Co.* (1913), 30 R.P.C., 199, the plaintiffs were the publishers of magazines called "The Magazine of Fiction" and "The Monthly Magazine of Fiction." The defendants, who were also publishers, had for many years issued a magazine called "Cassell's Magazine," and had lately changed the name to "Cassell's Magazine of Fiction and Popular Literature." The price of the plaintiffs' magazine was threepence, and the defendants' fivepence. The plaintiffs brought an action against the defendants claiming an injunction to restrain them from passing off their magazine as and for the plaintiffs' magazine, and gave evidence to show that when, on many occasions, persons had asked for "The Magazine of Fiction" the defendants' magazine had been tendered. At the conclusion of the plaintiff's case, and without calling on the defendants, it was held that the plaintiffs had proved no title to relief; that they had no right to the exclusive use of the words "Magazine of Fiction," which were purely descriptive words; and that there was no evidence of deception. The action was dismissed with costs.

BUSINESS NOTES.

Electrical Trade of Cuba.—A report has been issued by the Department of Commerce (Washington), prepared by a Special Agent of the Department, on the market for electrical goods in Cuba. The various classes of electrical work on the island are discussed in detail, and suggestions are made regarding the possibilities of developing the business in the future. The application of electricity to systems of lighting, power plants, especially in sugar mills, heating devices, and the numerous other miscellaneous uses to which electricity is put in Cuba, have all been studied. The report may be seen by British firms interested at the Department of Commercial Intelligence, 73, Basinghall Street, London, E.C. 2.

Prohibited Exports from Sweden.—The Swedish Government has prohibited the exportation from that country of electrical machines, such as generators, motors, and converters; also transformers and damping rollers, and stators, rotors, current collectors, magnet poles, and brush-holders, when exported separately.

Book Notices. — "Science Abstracts." A and B. Vol. XX. Part 5. May 26th, 1917. London: E. & F. N. Spon, Ltd. Price 1s. 6d. each net.

"*Proceedings* of the American Institute of Electrical Engineers." Vol. XXXVI. No. 5. May, 1917. New York: The Institute. Price $1.

"The Canadian Patent Office Record and Register of Copyrights and Trade Marks." Vol. XLV. No. 1. January 31st, 1917. Ottawa: J. de L. Tache. Price 20 cents.

Catalogues and Lists.—The Power Plant Co., Ltd., West Drayton, Middlesex.—Leaflet relating to flexible couplings in a variety of patterns.

Messrs. W. T. Henley's Telegraph Works, Ltd., Blomfield Street, E.C.—Folder giving details of a few of the Henley terminal boxes, wall type, stocked ready for delivery; also the Henley lead-cone gland and porcelain terminal ends. Revised list No. U104 (fifth edition) consists of 108 pages of well illustrated particulars, with tabulated sizes, reference numbers, and prices of a variety of Henley terminal boxes. The several sections deal with the following manufactures:—Lead cone and standard wiping glands, terminal boxes for indoor use, ditto for outdoor use, terminal boxes for telephone and multicore cables, colliery terminal boxes, porcelain terminal ends, miscellaneous boxes, and accessories. Since the last edition appeared, several additions have been made, and in the telephone terminal box section large reductions in prices have been made.

British Thomson-Houston Co., Ltd., 77, Upper Thames Street, London, E.C.—New 44-page list (No. 10,555A), containing very full information, with illustrations, prices, &c., of "Eye-Rest" indirect lighting fittings. Several new types of fittings are included. The contents show the extent to which the "Eye-Rest" equipment is now adapted for use with half-watt type lamps. The new list also contains complete details and illustrations of lighting installations, giving full illumination data and tables of values, thus permitting the ready solution of lighting problems with this form of lighting equipment. Special attention is drawn to the new "Eye-Rest" Portables, employing the indirect lighting equipment with half-watt type lamps with floor and table standards, thus giving an equipment which is independent of a ceiling fitting and can be used in any part of the room or removed from room to room as conditions require. The list is being distributed to all holders of B.T.H. Lamp and Wiring Supplies Handbook Binders, and copies can be obtained on application to the Lamp and Wiring Supplies Department at the address given.

Light Electric Motor Co., Baltic Street, Dundee.—A set of illustrated leaflets dealing briefly with various portable electric tools—electric drilling machines, electric grinders, motor-driven pumps, and grinding and polishing machines—and giving prices of same.

Spain.—A new company has lately been formed at Palma de Mallorca with a capital of £20,000 and the title La Sociedad Electro-Mecanico Industrial, to carry on an electrical and engineering business.

Bankruptcy Proceedings. — Brown, Frederick, electrician, Llanelly.—First and final dividend, 8s. in the £, payable at Official Receiver's Office, 4, Queen Street, Carmarthen.

Excess Profits Duty. — The Board of Referees has ordered, in response to an application by the Victoria Falls and Transvaal Power Co., Ltd., for an increase of the statutory percentage as respects "the business of supplying in bulk electrical power and power in the shape of compressed air in the Transvaal Province of the Union of South Africa," that the statutory percentage be increased to 9 per cent. in the case of companies or other bodies corporate and to 10 per cent. in the case of any other trade or business.

Liquidations.—Isaria, Ltd.—The controller, Mr. G. S. 140, Leadenhall Street, E.C., has applied for his release.

Trade Announcement.—Mr. F. Evill, who represents the Klein Engineering Co. (1908), Ltd., and the Timbrell and Wright Machine Tool and Engineering Co., Ltd., has removed to 159, Victoria Street, Westminster. Telephone: "Victoria 4561."

For Sale.—Messrs. C. A. Tricks & Son will offer for sale by auction, at Bristol, on June 12th and 13th, the electrical stock in trade, fittings, &c., of Mr. C. M. Simpson. Particulars are given in our advertisement pages to-day.

LIGHTING AND POWER NOTES.

Belfast.—Strike.—On the 1st inst. 72 semi-skilled and unskilled labourers employed at the Corporation electricity works went on strike for higher wages. The men contended that they should have had a rise of 5s. per week when that advance was given some weeks ago by the Committee on Production to the engineers and the members of certain Federated Unions in the employment of the Corporation Tramways. An arbitrator is to be appointed by Sir George Askwith, with a view towards an adjustment of the question. On the two days of the strike the services of light and power were carried on as usual.

Birmingham.—Year's Working.—The annual report of the Corporation electricity department for the year ended March 31st last, shows that the total number of units sold was 149,724,637 as compared with 117,016,321 units in the previous year, representing a revenue of £717,831, as compared with £498,962; over 29,000,000 of the 32,718,316 increase in the units sold was for extra-high-tension current, the increase in this item alone being over 55 per cent. The output for lighting and power, exclusive of tramways, shows an increase of 35 per cent., while the money value of this supply shows an increase of 50 per cent. After meeting all charges for interest and sinking fund, there is a balance of £67,794, of which sum £40,000 has been transferred to renewals, and the balance it is proposed to pay to the credit of the rate account.

In order to facilitate the handling of coal the Committee recommends the purchase of additional land at Nechells for railway siding accommodation, at a cost of £1,600.

The award of the arbitrator, Mr. W. W. Mackenzie, K.C., appointed by the B. of T. to consider the application of the employés of the gas, electricity supply, tramways, and water departments of the Corporation for an additional 5s. 6d. per week has been received. The grant is of 5s. per week for the first full pay day following the award, which is dated May 22nd.

Bray (Co. Wicklow).—Electric power has been installed in a new hosiery factory opened by the Technical Instruction Committee.

Canada.—The Ontario Hydro-Electric Commission has purchased the Ontario Power Co.'s plant and its transmission lines from the Niagara Falls for $22,000,000, as an addition to the Government-owned electric system of the Province.

Colne.—There has been a loss on the electricity undertaking for the past year of £1,300, due to the increased cost of producing current, price of coal, wages, and diminution of income from lighting.

Continental.—ITALY.—H.M. Embassy in Rome reports that the Ministry of War has been authorised to advance the sum of about £800,000 to the Ministry of Public Works, which, in agreement with the railways administration, will undertake the immediate installation of hydro-electric plant for the production of power. The power generated will be placed at the disposal of factories working under Government control, but the installations will eventually pass under the control of the railways administration, and should the railways administration have no immediate use for them the Ministry of Public Works will operate them for account of the railways.—*Board of Trade Journal.*

Dublin.—Considerable discussion recently took place in the Council on the decision of the Special Committee providing for the appointment of Mr. M. Ruddle, city electrical engineer, to control the electrical undertaking for a period. It was complained that the Council had had no opportunity of considering the decision, and eventually it was decided that the matter should be dealt with at a special meeting of the Council.

Exeter.—The City Council has passed a resolution urging that municipal electrical authorities should have greater representation on the B. of T. Electricity Committee.

Folkestone.—E.L. PURCHASE DEFERRED.—The T.C. has decided not at present to give notice to purchase the undertaking of the Electricity Co. The next period which gives the Council the option is six months before July 2nd, 1918.

Greenock.—The Harbour Trustees have recently brought into use a fitting-out crane of the electric cantilever type, made by Sir William Arrol & Co. It deals with 150 tons at a maximum radius of 85 ft., and reduced loads at greater radii up to 132 ft. The overall length of jib is 230 ft., and a hook lift of 150 ft. above the quay is possible.

Hebden Bridge.—BULK SUPPLY PROPOSALS.—The U.D.C. has decided to consider a report in Committee as to the purchase of a bulk supply of electricity from the Halifax Corporation.

London.—HACKNEY.—The recommendations of the Electricity Committee for a general increase in the price of electricity having been referred back for further consideration, the Council considering the present not an opportune time to determine upon a comprehensive revision of the scale of charges, the Committee recommended that the rates for lighting, cooking, and other domestic purposes and for power and charging batteries should be increased by a further 10 per cent., and the Council agreed.

Nottingham.—YEAR'S WORKING.—A preliminary announcement regarding the past year's working of the Corporation electrical undertaking states that 14,717,000 units were sold, being 862,000 more than in 1915-16, the increase being due to the growing power load, in connection with which 2,155 motors of 9,420 H.P. are in use. New connections during the year reached a record; there are now 5,007 consumers and three generating stations—viz., Talbot Street, 6,810 H.P.; St. Ann's, 9,500 H.P.; and Eastcroft destructor station, 720 H.P.; making a total of 17,030 H.P.

Salford.—YEAR'S WORKING.—The annual report of the Corporation electricity department for the year ended March 31st last shows that the total output sold amounted to 29,572,331 units, as against 24,856,435 units in 1916. The revenue increased from £133,764 to £156,953, and after meeting operating expenses, the gross profit was £70,924; the net profit, after the payment of interest and sinking fund charges, was £21,354 as compared with £16,598 in the previous year. The average working cost per unit sold was :—·538d., as compared with ·504d. in 1916 and ·561d. in 1915, the cost of coal per ton being 12s. 2½d. for 1915, 15s. 1¾d. for 1916, and 17s. 6½d. for 1917.

Shipley.—The U.D.C.'s electricity accounts for the year ended March 31st show an income of £16,347, as compared with £15,497 in the previous year, the increase being chiefly due to enhanced sales for power. The cost of coal and labour increased by £1,680, and loan charges increased by £440. It was chiefly due to the increased cost of coal that there was a loss on the year's working of £341. Mr. E. Reynolds, chairman of the Electricity Committee, said they had considered how to meet the debit balance and future increased charges, and recommended no alteration of charges for lighting, but a flat rate of 1¾d. per unit for power purposes, and that the previous two advances of 10 per cent. each should be increased to 25 per cent. on the scale of charges for power, the increases to date from July 1st. This recommendation was adopted by the Council.

Slaithwaite.—The B. of T. has extended the 1914 Electric Lighting Order for one year.

South Africa.—According to the *British S.A. Export Gazette*, the new municipal tailoring department at Johannesburg is being equipped with electrical sewing machines, irons, and other appliances.

Southport.—WAR BONUS.—The war bonus recently granted to the Corporation employés will increase the amount paid under this head by £6,000, bringing the total to over £10,000. Including other bonuses and war allowances, the total additional expenditure owing to the war is over £20,000, and nearly equal to a rate of 10d. in the £.

Spenborough.—WAGES.—The employés at the Council's electricity and destructor works have made application for an advance in wages. The Electricity Committee has appointed Messrs. Blackburn and Heywood to discuss the matter with representatives of the men.

Todmorden.—During the past year the Corporation electricity undertaking sold 422,000 units, of which 321,536 were for power, the maximum load being 290 KW., and load factor 16·6 per cent. The total connections to the mains were 785 KW., made up of lighting, 359 KW.; power, 362 KW.; and heating, 63 KW. The average works cost was 2·19d. per unit sold; the average price for lighting was 4·85d., and for power, 1·15d. per unit. The question of increasing the price of energy is now before a Sub-Committee.

Worcester.—YEAR'S WORKING.—The accounts of the Corporation electricity undertaking for the year ended March 31st show a profit of £812, but new plant to the value of £986 having been provided out of revenue, there is a deficit of £173. A record output had been obtained from the hydro-electric plant on the Tame at Powick, and the engineer, Mr. C. M. Shaw, suggests that the water power at Diglis Weir, on the Severn, should be utilised, as he considers that 1½ million units per annum can be generated thereby, and a substantial margin of profit, at a selling cost of a ½d. per unit, obtained.—*Birmingham Daily Post.*

Yeovil.—The B. of T. has extended the Yeovil Electric Lighting Order of 1914 for a year.

TRAMWAY and RAILWAY NOTES.

Accrington.—FARES.—The Tramways Committee has recommended that the recently-revised workmen's fares be modified as follows :—That the original workmen's 1d. fares be fixed at 1½d., in lieu of 2d. recently charged, and the original 2d. fares be increased to 2½d.

Birmingham.—FARES.—The Tramways Committee is of opinion that it is necessary (1) that all existing stages be increased so as to allow passengers to ride approximately two miles for 1d.; (2) that all return tickets be abolished, with the exception of those on the 2d. and 2½d. stages; and (3) that the return tickets on these stages be issued to passengers riding before 8 a.m., at 3½d. and 4d. respectively.

Bolton.—In view of the arbitration proceedings pending on the men's applications for a 10s. war bonus, the amount of the rate contribution from the Corporation tramway department has not been announced, but it is stated that it will exceed the estimate of £15,500. Last year the sum was £17,000. The Finance Committee of the Council, it is stated, is asking for a much larger rate aid next year, and if this demand is met it will mean increased fares.

Burnley.—WAGES.—The threatened strike of tramway workers in Burnley and 20 other centres has for the time being been averted, the B. of T. having intervened. The men and women workers asked for 10s. per week advance, but the various Corporations affected declined the application. The Burnley Tramways Committee has agreed to refer the matter to the Committee on Production, and to join the Lancashire and Cheshire tramway authorities, who are preparing for arbitration upon the same application.

Eccles.—The *London Gazette* for June 5th contains the full notice of the intention of the Eccles Corporation to lease the tramways within the Borough of Eccles to the Salford Corporation for 35 years from 1904, with particulars of annual and other payments to be made by the latter in respect thereof.

Glasgow.—YEAR'S WORKING.—As was anticipated by earlier paragraphs in the REVIEW, the statistics just issued for the financial year of the T.C.'s tramways department show that both the traffic and revenue have been greater than ever before—the records easily eclipsing the previous best. The revenue amounted to £1,245,508, an increase of £96,243 compared with the previous year, while the passengers carried totalled 388,294,876, an increase of 25,923,412. The record year is attributed to the fact that the suburban train service has been considerably curtailed and also to the vast increase in the number of women factory workers. One of the features in the returns is, while the number of passengers carried at each of the several fare denominations—½d. to 4d.—was greater than in the preceding year, the increase in the number of passengers carried for the ½d. worked out at over 15,000,000. About 248,000,000 ½d. fares and over 100,000,000 1d. fares were taken. The average track mileage (single) open during the year was 196¼—the same as in the corresponding period of 1915-16, and the car-mileage was 25,786,047—increase 822,738. The receipts per car-mile worked out at 11·592d.—increase ·543d.—and the receipts per passenger at ·769d., increase ·008d.

LOTTERY TICKETS: LEGAL POSITION.—Public interest in the position of the prize drawing promoted by the Tramways Department to raise money for war charities, is extending. About 10 days ago the Lord Advocate declared that the "draw" was of the nature of a lottery, and stated that he would be glad to hear what the T.C. had to say in the matter, while the General Assemblies of

the Scottish Churches condemned the movement as an incentive to public gambling. The Committee suggested that the Lord Advocate should receive a deputation, and hear the case stated, but the Chief Crown Officer for Scotland asked that the communications be confined to writing. At a meeting of the Committee, this week, the whole position was discussed, and several letters were submitted from representative bodies and public men throughout the country, strongly supporting the "draw," and urging its extension to other large tramway systems. The question of the relation of the Art Union to this "draw" was discussed, and while it was recognised that probably the tramway's efforts would not meet the precise terms of the Art Union Act of 1846, which recognised associations having for their object the distribution by ballot of works of art, or of money prizes to be expended on the purchase of works of art, it was thought that, either by an extension of the statute referred to, or by the passing of a special Act authorising the tramway prize-drawing, and such like, but confining the working thereof to public authorities, there might be legalised what was regarded as a technical breach of the statute. The Lord Advocate is again to be written to for an interview.

Hull.—YEAR'S WORKING.—The annual accounts of the Corporation tramways for the year ended March 31st show total receipts amounting to £170,175 and a total expenditure of £172,624, leaving a deficit of £2,449, which has been taken from the reserve fund. During the year, 24,686,045 passengers were carried at 1d. fares and 29,439,168 at ½d. fares, the total fares showing an increased value of £2,245 on the previous year.

Keighley.—It is understood that intimation has been made by the Chief Industrial Commissioner's Department of the B. of T. to the Corporation tramway employés, recently on strike for a higher war bonus for the women, that the dispute has been referred to arbitration, which will be heard locally at an early date.

The Tramways Committee has recommended the discontinuance of the issue of cheap prepaid tickets, and the establishment of a uniform fare of 1d. for passengers over 13 years of age for a continuous journey of any distance between any two termini on the local service.

Lancaster.—YEAR'S WORKING.—At last week's meeting of the T.C. it was reported that there was an actual deficit on the tramway undertaking for the past year of £69, but this was unusually small, and the chairman of the Tramways Committee expressed confidence that they were getting near the day when the tramways would pay.

TELEGRAPH and TELEPHONE NOTES.

Church Telephones.—The worshippers in the St. George's Road Congregational Church, Bolton, have had an installation of electric church telephones put in to enable partially deaf people to participate fully in the services. Fixed in front of the pulpit is the transmitting instrument, with wires to the pews connected, where worshippers will use inconspicuous receivers.

Edinburgh-Glasgow Telephone Service.—According to the *Telegraph and Telephone Journal*, a new underground cable between Edinburgh and Glasgow has enabled a service of junction quality to be provided between a large number of telephone exchanges on the east and west of Scotland respectively.

Hull.—An arbitration award gives concessions as follows to employés of the Hull Corporation telephone service:—5s. to men and 4s. a week to women earning under 30s.; 4s. and 3s. to those exceeding 30s. and under 60s.; and 5s. and 3s. 6d. to those exceeding 60s. a week and not exceeding £250 a year. As a consequence, the Corporation is considering whether it will be necessary to increase the tariffs.

Post Office Revenue and Expenditure.—When the House of Commons on Tuesday went into Committee on the vote of £13,400,000 for the Post Office, Mr. Illingworth, in his statement as Postmaster-General on the work of the Post Office, said it had been rendered specially difficult by reason of the fact that 75,000 of the younger men had been called up for military service, of whom, he regretted to say, 3,829 had been killed. Decorations had been bestowed in 755 cases.

The net revenue for 1916-17 was ...	£2,320,000
As against, in 1915-16	£4,430,000
And in 1913-14	£6,655,000

The explanation was that an enormous amount of work was done for other departments for which the Post Office had not been paid. As to the telephones, the estimated additional revenue from the alteration of the flat rate was £280,000; the actual additional revenue for 1916-17 only amounted to £120,000. By the end of the present financial year the revenue from this source would probably amount to £230,000. The actual additional revenue from increased trunk fees for 1916-17 was £220,000. Capital expenditure had been kept down as much as possible. The London capital expenditure for 1915-16 was £370,000, and for 1916-17 £93,000. In the Provinces in 1915-16 the expenditure was £882,000, and in 1916-17 £196,000. The number of paid telegrams was still declining. It was 16 per cent. lower in 1916-17 than in 1913-14, and 13 per cent. lower than in 1915-16. The ordinary traffic had fallen from 72,199,000 in 1914-15 to 54,249,000 in 1916-17. The number of Government telegrams dispatched free had increased from 617,000 in 1913-14 to 8,012,000 in 1916-17. The net receipts, however, were only £50,000 less than last year, and more than £300,000 over the receipts of 1913, attributable to the increase of the rate from 6d. to 9d.—*Daily Telegraph*.

The Coming-of-Age of Wireless Telegraphy.—In the *Wireless World* for June, Dr. J. A. Fleming points out that this month marks the completion of 21 years from the date of Senatore Marconi's first British patent, embodying the use of the aerial wire and the earth connection, which provided the key to success in etheric telegraphy. Dr. E. W. Marchant also writes in the same issue on the remarkable achievements of the period. A biographical note sketches the career of the distinguished inventor himself, and an historical *résumé* describes the progress of the Marconi system from the commencement. As a proof that wireless signals could now be sent round the earth with only two relays, it is stated that the San Francisco Marconi station is easily readable at Clifden, Co. Galway; the station at Nauen, near Berlin, at Funabashi, Japan; and Funabashi at San Francisco.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—SYDNEY.—August 22nd. N.S.W. Government Railways and Tramways. Thirty-six induction motors (Specification No. 488). September 19th.—One 225-H.P. synchronous motor (Specification No. 489). Particulars from Electrical Engineer's Office, 61, Hunter Street, Sydney.

MELBOURNE.—July 25th.—Victorian Railways. Step-down transformer and sub-station equipment for Sandringham-Black Rock electric tramway. Particulars from the Chief Storekeeper, Railway Offices, Spencer Street, Melbourne.

Newport (Mon.).—June 9th. Tramway Department. Construction of the Newport Light Railway, Section No. 2. See "Official Notices" June 1st.

Spain.—The municipal authorities of Berlanga (Province of Badajoz) have lately invited tenders for the concession for the electric lighting of the town during a period of six years. The concession for the electric lighting of the town of Deva (Province of Guipuzcoa) for ten years was also recently put up to tender.

York.—June 11th. Coal for one year for the Corporation electricity works (approximately 17,000 tons). Mr. J. W. Hame, Electrical Engineer.

CLOSED.

Birmingham.—Corporation:—
Vaughan Crane Co.—Electric hoist, £3,095.
British Thomson-Houston Co., Ltd.—Turbo-exhauster, £1,606.

Glasgow.—T.C. Gas Contracts Committee:—
Malcolm & Allan, Ltd.—Work and material for the electrical installation to benzol plant at Tradeston Gas Works.
Allan, Arthur & Ure.—Electric light installation at the small hall of the Coupar Institute, Cathcart, £178.

The Trustees of the Clyde Navigation:—
Carbons.—John T. Cartwright, and General Electric Co., Ltd.
Cab tire cable.—Johnson & Phillips, Ltd.
Switch, plug, and fuse boxes.—Dorman & Smith, Ltd.

Manchester.—Electricity Committee. Accepted tenders:
Cable.—W. T. Glover & Co., Ltd.; Callender's Cable and Construction Co., Ltd.
Steelwork for boiler house.—Morton & Co., Ltd.
Turbine-driven boiler feed pump.—G. & J. Weir, Ltd.

Salford.—T.C. Accepted tenders:—
Albion Clay Co., Ltd.—Stoneware conduits for supply to the Manchester Ship Canal Co.'s Irwell Park Wharf, £419.
British Westinghouse Co.—Switchgear at Irwell Park Wharf, £410; H.T. switchgear in connection with cable to be laid to Trafford sub-station, £363; ditto, at Blackfriars sub-station, £378.
W. T. Glover & Co., Ltd.—Lead-covered feeder cable, £2,474.
Bertram Thomas.—L.T. switchgear at Blackfriars, £402.

Todmorden.—1,000 tons of coal for the municipal electricity department: Mr. James Mitchell.

FORTHCOMING EVENTS.

Physical Society of London.—Friday, June 8th. At 5 p.m. At the Imperial College of Science, South Kensington, S.W. Ordinary meeting.

Royal Institution of Great Britain.—Friday, June 8th. At 5.30 p.m. At Albemarle Street, W. Lecture on "Industrial Applications of Electrons," by Prof. Sir J. J. Thomson, Pres. R.S.

Saturday, June 9th. At 3 p.m. Lecture VI, on "The Electrical Properties of Gases," by Prof. Sir J. J. Thomson, Pres. R.S.

Salford Technical and Engineering Association.—Saturday, June 9th. Visit to Messrs. Taylor Bros. & Co., Ltd., Trafford Park.

North of England Institute of Mining and Mechanical Engineers.—Saturday, June 9th. At 2 p.m. At the Wood Memorial Hall, Newcastle-on-Tyne. General meeting.

Institution of Mining Engineers.—Friday, June 15th. At 11 a.m. At Burlington House, Piccadilly. General meeting.

OUR HALF-YEARLY INDEX.

As it is necessary to effect every possible economy in paper consumption, the Index to Vol. 80 of the ELECTRICAL REVIEW, which will be printed in the course of a few weeks, will be supplied only to those who, through the post, specially apply for it. To such it will be supplied for 3d. post free. Any reader or advertiser at Home or Abroad who requires a copy for binding, or for other purposes, is asked to make application therefor promptly to: The Publisher, ELECTRICAL REVIEW, 4, Ludgate Hill, London, E.C. 4.

NOTES.

Electrification of the Suburban Lines on the French State Railways.—Although hampered by the war, the work of electrification of the suburban lines of the Chemins de fer de l'Etat is being proceeded with, and some interesting details of the equipment are given by A. Soulier in *La Nature* for May 19th.

The supply will be three-phase at 15,000 volts and 25 cycles, and will be derived from two generating stations. The current thus produced will be transformed at sub-stations into continuous current. The generating stations themselves are not yet complete, but one of the largest transformer sub-stations has been finished—viz., the Cardinet sub-station.

This sub-station has been built to deal with the power required by the section over which traffic is heaviest. It is divided into two parts—viz., the traction sub-station, where the three-phase supply is received at 15,000 volts and 25 cycles, and the power and lighting section, where the H.T. three-phase supply is transformed to 5,000 volts. In the latter section, the pressure has had to be reduced to 5,000 volts to permit of using the gear in the old sub-station, which was arranged to work at this pressure.

The current, arriving at these two pressures, is carried to a distributing centre which permits either of its distribution to neighbouring sub-stations or of its use in the Cardinet station itself. Groups of special transformers permit of changing over from one pressure to another. The frequency is the same at all pressures, so that if an accident happens to one supply line, another can be substituted, thanks to a suitable combination of transformers. Section switches, pressure regulators, lightning arresters, &c., are provided where the H.T. current enters the sub-station. Before reaching the transformers the current has to pass through special safety-cooled oil switches.

Traction Section of Sub-Station.—In this section the H.T. current is transformed down to 650 volts—*i.e.*, the track pressure. After the voltage of the alternating current has been reduced, the supply is fed to the rotary converters. There are at present four converters installed, each of 1,500 KW., thus giving a total output of 6,000 KW. Two others will be installed of the same power. The section is provided with two large fans, each absorbing 40 H.P. and driven by an asynchronous three-phase motor; they remove the hot air from around the transformers, and keep the temperature within reasonable limits. It is estimated that 5 per cent. of the total energy involved in transforming is lost in the sub-station in the form of heat.

The converters are of the 12-pole six-phase type—*i.e.*, having six slip rings connected in pairs to the secondaries of three single-phase transformers, the primaries of which, at 15,000 volts, are star-connected. These machines start up on the three-phase current and come into step automatically.

Lighting and Power Section.—Two groups of converters of 600 KW. have been installed, and there is room for a third. Each group comprises a three-phase 5,000-volt synchronous motor coupled to a 600-KW., 500-volt generator. The motors have squirrel-cage rotors.

Two balancing generators, each of 100 KW., at 250 volts, coupled together, serve to balance the two three-wire distributing bridges which feed the neighbouring stations. Two storage batteries complete the equipment.

Rolling Stock.—The motor coaches each have two drivers' stands (one at each end). They are of the latest type, mounted on triple axle bogies; each of the two end axles of each bogie is provided with a 160-H.P. motor, so that the car has available 640 H.P., *i.e.*, 8 H.P. per ton weight, since the total weight under load is 80 tons. The coaches are coupled up on the Boirault system, which prevents the accidents which so often happen when a man has to pass between the buffers. The third rail of the system is somewhat different from those generally adopted. Contact can be made by the slipper either above or below the rail.

Volunteer Notes.—COUNTY OF LONDON ENGINEER VOLUNTEERS (FIELD COMPANIES).—Headquarters, Balderton Street, Oxford Street, W.

Orders for the Week. By Lieut.-Colonel C. B. Clay, V.D., Commanding:—

Monday, June 11th.—Technical for No. 3 Company, Right Half Company, at Regency Street. Drill, No. 3 Company, Left Half Company. Signalling Class. Recruits' Drill, 6.30.

Tuesday, June 12th.—Lecture, 6.30. Sergeant Instructor Higgs, "Pontooning." Physical drill and bayonet fighting, 7.30.

Wednesday, June 13th.—Drill, No. 1 Company, Right Half Company, 6.15.

Thursday, June 14th.—Drill, No. 2 Company, Right Half Company. Ambulance Class, 6.30. Signalling.

Friday, June 15th.—Technical for No. 3 Company, Left Half Company, at Regency Street. Drill, No. 3 Company, Right Half Company. Recruits' Drill, at 6.30 to 7.30.

Saturday, June 15th.—Commanding Officer's Parade, 3.0, at Putney Bridge Station, for Route March.

Sunday, June 17th.—Parade Clapham Common (Tube Railway), 9.45 a.m., for work at Bombing School. Uniform. Rations to be carried.

MACLEOD YEARSLEY, *Adjutant.*

Electricity Works Holidays.—In considering the arrangements to be made for the annual leave of the staff and workmen under its control, the Lighting Committee reported to the Islington Borough Council that with regard to those employés who had not been in the service of the Council for 12 months, and who, under the existing regulations, were not entitled to an annual holiday, it was of opinion that it was in the interest of both the Council and the employés (having regard to the present abnormal conditions), that the latter should be granted some respite during the summer months. The Council agreed with the view put forward, and the electrical engineer was instructed to make arrangements accordingly.—*Morning Advertiser.*

British Engineers' Association.—Mr. Wilfrid Stokes, president of the British Engineers' Association, presided, on Wednesday last, at an extraordinary general meeting held to adopt the new memorandum and articles of association which had been approved by the Board of Trade. The meeting was attended by members from all parts of the country, and after the formal resolutions had been passed, considerable interest was taken in the discussion on the wider programme of the Association. Mr. Stokes explained that the necessity for the new powers contained in the memorandum had arisen from the fusion of the Manchester movement for the organisation of the British engineering industry with the British Engineers' Association. In order to give manufacturing engineers the advantage of close consultation with large buyers, users and others, new classes of membership had been created for the Engineering Departments of Public Services and companies and for individual engineers.

Mr. Harry Allcock stated that the circular letter issued to members with regard to the proposals for the organisation of the Association into Trade Sections had met with a most encouraging response, showing that this action would meet a felt want. It was explained that there was no suggestion of interfering in any way with existing Associations already formed for certain branches of the industry, but that these would be invited to co-operate with the British Engineers' Association.

Mr. Arthur Jacob dealt with the question of engineering education and research, and, on his proposal, it was decided to form a Sub-Committee to formulate a scheme for the co-ordination and extension of the educational and research movements at present in existence.

The President briefly reviewed the history of the Association's operations in China, and referred to the greater interest being taken by the Foreign Office in trade developments in that country, as evidenced by the assistance given by Mr. Archibald Rose, H.M. Commercial Attaché at Shanghai, during his visits to the commercial centres of this country. The Association is considering the adoption of an extensive educational and pioneering scheme in China on behalf of the British engineering industry.

Mr. Stokes, in his remarks on the difficult problems of after-the-war reconstruction, which included the relations of Capital and Labour, the future control by the Government of industry, the extension of overseas trade, transport and shipping questions, and research, urged upon manufacturers the importance of co-operating, in order to find some solution of these questions for themselves.

Nickel in Ontario.—In the *Journal of the Royal Society of Arts* an advance summary of the report of a Commission appointed by the Government of Ontario to report on the nickel industry of the province is given. It is stated that the nickel ore deposits of Ontario are much more extensive and available than those of any other country. The electrolytic process of refining is the most suitable for Ontario, where electric power is cheap and abundant. Two large refining plants are being erected in Ontario, one to have an initial output of 15 million lb. per annum, by thermal methods, the other—that of the British-American Nickel Corporation, Ltd., which is controlled, and largely financed, by the British Government—to have an output of 5,000 tons per annum by the Hybinette electrolytic process. The output of these two refineries, added to that of works in England refining Ontario nickel matte, will fully meet the entire requirements of the British Empire. It is anticipated that the uses of nickel will be greatly extended after the war. The electrolytic refining process is employed in Norway, the whole output being taken by Germany. The report is stated to be a "veritable encyclopædia of information" on every phase of the nickel industry and trade.

Electric Steel.—According to the *Iron Age*, during the past three years the electric steel furnace has established its position as an important factor in steel production. The United States possesses 136 furnaces, nearly twice as many as a year ago, and last year their output was more than doubled, amounting to 175,000 tons. The estimated output of electric steel in Germany in 1916 was 225,000 tons. At least 88 furnaces are in use in this country, and the probable output of the world within a year or two after the end of the war is estimated at one million tons per annum. In addition to the countries named above, Italy and France are credited with 29 furnaces each, Sweden with 40, Canada with 19, and Russia with 16, while the world's total is given as 471 furnaces for the refining of steel; of these, 181 are of the Héroult type, 70 Rennerfelt, 50 induction, and the remainder Girod, Stassano, Snyder, Electrometals, Greaves-Etchells, &c. The electrical smelting of iron ore is also progressing, Sweden possessing 17 furnaces of 2,000 to 6,000 H.P., with a probable output last year of 100,000 tons of pig-iron.

X-Ray Equipment.—Ealing Chamber of Commerce has undertaken to raise £750 to provide the Ealing King Edward Memorial Hospital with an X-ray equipment.—*Times.*

Irish Agricultural College and Electricity.—In connection with the establishment of a new Agricultural College at Mount Mellary, near Cappoquin, Co. Waterford, electrical power has been introduced, and electrical training will be one of the branches to which students will be invited to give attention. Electric light in the gardens will be used in the dark of winter mornings or evenings to help in urgent work.

Durban's Electrical Plant.—The *British South African Export Gazette* very justly remarks that what Mr. J. Roberts, borough electrical engineer, Durban, was able to accomplish for the Municipality during his recent visit to England on its behalf, suggests that it would not be a bad plan if more officials occupying similarly responsible positions throughout the Union were sent home now and again for the purpose of investigation and personal consultation with experts at this end. It seems that the armature of a high-speed generator driven by a turbine failed, and, on Mr. Roberts's advice, the armature was sent to England for repairs, as the work of re-winding was altogether too technical and difficult a matter to be undertaken locally. On his own suggestion, the Council instructed Mr. Roberts to come to England for the purpose of using every effort to get the repairs executed expeditiously, and of ascertaining what recent developments had taken place in the manufacture of other plant which the Council agreed would presently have to be installed." The visit has, we learn, been entirely justified by results. Thanks to the fact that he was in London, Mr. Roberts was able to buy a spare armature from Messrs. C. A. Parsons & Co., Ltd., and have it promptly shipped out to Durban. As a matter of fact, it was actually placed in service within three months of the original breakdown. With reference to the pushing forward of other plant required by the Municipality, Mr. Roberts was able to secure early delivery from the manufacturers of a large condenser, which was badly needed, as well as of other less important plant long overdue, including 500-KW. transformers. In all, by his energy and foresight, the borough electrician appears to have saved the Council much valuable time, and local business men a vast amount of inconvenience and monetary loss. When we state that the amount estimated to be spent is £18,000, and that the total cost to the Council of Mr. Roberts's visit was £223, it is not too much to say that the expenditure was amply justified, although it was made the subject of some criticism by those worthy people who never quite realise what it is to be penny wise and pound foolish."

Our contemporary's remarks are perfectly correct; it pays, and pays handsomely, to send the engineer home at intervals of a few years, to get into touch with manufacturers, and to study the latest developments in electricity supply, which is never at a standstill. We have repeatedly observed the beneficial results of such visits, and cordially commend this policy to electrical authorities in the Dominions and Colonies.

Nitrogen from the Air.—The National Efficiency Board has invited Mr. J. Orchiston, chief electrical engineer to the Post and Telegraph Department, to report on his proposal for establishing an industry in New Zealand for producing nitrates from the air. Mr. Orchiston has acquired data dealing with the cost of hydro-electric schemes in Germany, Norway, and Italy; and in no case, he said, can electricity be generated as cheaply as it could be done by utilising any of the large falls in the south-western sounds of New Zealand. One of the simplest propositions is that presented in utilising the Bowen Falls, in the Milford Sound. He estimates that after making full allowances for all contingencies, energy could be produced for one-fiftieth part of a penny per unit, or 1 H.P. at at a cost of £1 per annum. For nitrogen fixing from the air, Mr. Orchiston doubts if there is a more favoured spot in the world, for at the Bowen Falls there is deep water close to the side of the sound, and perfect shelter in all kinds of weather.—*Auckland Weekly News.*

The B.A. Meeting.—As already stated here, the meeting of the British Association, which was to have taken place at Bournemouth in the autumn, has been cancelled. Annual and other members are asked to maintain their subscriptions as usual, as it would be regrettable if the research work of the Committees, some of which is of great importance, in connection with circumstances arising out of the war, had to be curtailed. A meeting of the General Committee will take place at Burlington House on Friday, July 6th, at 12 noon.

U.S. Electrical Exports.—The electrical exports of the United States in 1916 exceeded in value eight million pounds sterling, compared with less than four millions in 1914 and less than five millions in 1915.

Electric Furnaces for Ferro-Alloys.—The Priestman Collieries, Ltd., made experiments in the manufacture of ferro-silicon at Rowlands Gill in a small electric furnace. On the strength of the results of these experiments they erected larger furnaces, until now they have a 2,000-KW. furnace producing from 10 to 15 tons of ferro-silicon per day. During the last four or five years they have successfully produced 25 per cent., 50 per cent., 75 per cent., and a short time ago 95 per cent. ferro-silicon, the latter of which was of exceptional purity. They have now under consideration a scheme for the production of from 1,000 to 2,000 tons of this material per year. The next alloy they took in hand was ferro-molybdenum. They experienced considerable difficulty in making this alloy, on account of its very high melting point and the difficulty of getting rid of objectional impurities, but are now producing an alloy of excellent quality, testing over 80 per cent. of molybdenum. At the beginning of the war it was discovered that there were practically no stocks of ferro-chrome in the country. They were asked to make that alloy, and within three or four weeks of the outbreak of the war were in a position to supply their customers. Since then they have made large quantities of all grades of ferro-chrome, with carbon content ranging from ½ per cent. to 10 per cent. Two or three months after the outbreak of the war a large demand for ferro-tungsten for the manufacture of high-speed steel set in. To make that material they erected a special furnace house filled with furnaces suitable for the manufacture, and are now producing between 300 and 400 tons of ferro-tungsten a year.—*Iron and Coal Trades Review.*

Ice on Transmission Line.—During a severe sleet storm, Mr. Stuart Van Buren successfully prevented ice forming in dangerous quantities on the conductors of a transmission line, by using the heating effect of the current. This line was of double-circuit construction, connecting a large power house with a sub-station 50 miles away. Under normal conditions, the two circuits were operated in parallel at 60,000 volts. As the storm occurred during light-load operation, the line current was not sufficient to produce the desired heating effect. It was therefore decided to use wattless current.

In order to do this, the two lines were first separated at the power house with one generator on each line, but were left in parallel at the sub-station end. Next, the field excitation was raised to the limit on one machine, and was lowered as much as possible on the other. This set up a heavy wattless current between machines, which was forced to flow over the transmission lines through the sub-station loop. This scheme proved effective in keeping the ice on the wires within safe limits.—*Electrical World.*

Society for Electrical Development.—At the annual meeting of the Society, which was held on May 8th, at New York, resolutions were passed unanimously pledging the Society to support the President in all measures necessary to maintain the honour of the country and the rights of its citizens, and to keep business moving, including the preparation of all electrical systems for the added demands that might be made upon them. Mr. Henry L. Doherty was re-elected president for the ensuing year, and Mr. W. H. Johnson chairman of the Executive Committee. A Committee was appointed to deal with the "Organisation of the Industry," with Mr. J. H. McGraw as chairman, and two representatives of each of the four sections—manufacturers, contractors, central stations, and jobbers—each pair forming a Sub-Committee, whose duty it is to ascertain what their particular branch of the industry wishes the Society for Electrical Development to do for them. The "Organisation of the Industry" Committee will then discuss the various suggestions, and formulate plans to be submitted at a meeting of the board of directors of the Society. The Society points out that electricity in every walk of life conserves time, labour, energy, and money, and thus can lend powerful aid to the country during this time of stress.

Appointment Vacant.—Assistant telegraph engineer (£360), for the Post and Telegraph Department, Federated Malay States. See our advertisement pages to-day.

Fatality.—At an inquest at Bakewell into the death of Joseph Burrows (50), employed at the D.P. Accumulator Works, a verdict of "Nephritis," brought about by the absorption of lead, was returned.

Legal.—LONDON UNITED TRAMWAYS, LTD.—In the Chancery Court on Tuesday, Mr. Justice Eve granted a motion for the appointment of a Receiver for the London United Tramways Co., Ltd. The company, it was stated by counsel, submitted to the appointment. Originally £825,000 debenture stock was issued, and there had been further issues of stock totalling almost another £825,000. The reason for the appointment was stated to be the company's announcement of its inability to pay interest on the debenture stock due on July 1st. (The matter is referred to in the directors' report, which is abstracted in our "City Notes" to-day.)

Prohibited Exports.—The Supplement to the *Board of Trade Journal* of June 7th contains complete lists of articles which, according to the latest information received by the Board of Trade, are prohibited to be exported from Norway, Portugal, Russia, Spain, and Sweden. The Supplement also contains a reprint of the United Kingdom Contraband List in its present form.

The Work of the Central Electrical Laboratory at Paris.—Interesting particulars are given of the above institution in the current number of the *Bulletin* of the Société d'Encouragement pour l'Industrie National. The laboratory, whose director, M. Paul Janet, is responsible for the article in question, is governed by the Société Internationale des Electriciens, under an arrangement with the French Government. Its main activities are two:—(1) Tests and measurements on instruments and materials carried out for the public; and (2) research work.

As regards (1), the majority of Government departments depend on the laboratory for the very varied test work which they require carried out.

The Ministry of Marine entrusts that institution with the tests on new types of storage batteries for submarines and acceptance tests on lamps for the Fleet. The tests made for the War Ministry include the measurements on instruments used for acceptance tests of electrical material, and acceptance tests on electrical material used in powder factories.

Another department entrusts the laboratory with the testing of lightning arrester, &c., installations on public buildings. For the Public Works Department investigations are made into the types of meters used by municipalities, &c., for electric supply.

The laboratory has also carried out important experiments on the physiological effects of electricity for a Commission appointed by the last-named Ministry.

The research work has been of a very varied nature, and comprises:—An extensive investigation into the various qualities of carbon used for dynamo brushes; researches by M. Jouaust on the magnetism of iron, its magnetic viscosity, and its permeability at high frequencies; MM. Laporte and de la Gorce's researches on the dielectric strength of insulating materials under alternating and continuous pressures and varying frequencies; and, finally, the very considerable work by M. H. Bureau (now deceased) on insulated wires and cables and on insulating cloths.

With regard to the transmission of energy, M. David has carried out oscillographic researches on one of the most extensive networks in France, *i.e.*, that on the Mediterranean coast, which are very valuable and important in that they were made on an actual supply system, and not in the restricted area of a laboratory.

In photometsy reference may be made to M. Laporte's investigations on Violle's platinum light standard—the first experiments to be made in France on this subject since the classical memoirs of M. Violle.

Messrs. Broca and Laporte have studied the action on the human eye of various artificial sources of light, while Dr. Weiss and M. Ch. David have carried out a research on the mechanism of death by H.T. alternating currents.

The laboratory has worthily represented France at various international conferences, in which connection mention may be made of the international experiments carried out at Washington as the result of the International Conference on Electrical Units and Standards, held in London in 1908.

Various papers have been published on this question of electrical units.

Irish Peat Utilisation.—Among various suggestions recently advanced for Irish industrial development, one that has received a good deal of attention is the utilisation of the vast peat bogs of the country for electrical purposes. At the annual Congress in Dublin, last week, of the Irish Technical Association, Dr. J. H. Grindley read a paper on the peat resources, entering a strong plea that the Government and the newly-established Research Council should have impressed upon them the urgent need for assisting in this direction by research work on the basis of nationalisation; and Dr. J. F. Crowley submitted a paper dealing with the cheap distribution of power. Sir Thos. W. Russell, Bart., Vice-President of the Technical and Agricultural Department, said that the peat question had got into the worst possible hands, and warned the Congress that if scientists were going to deal with it, they should remember that they could not take the peat bogs out of the hands of the peasants, to whom they were a necessity, without considerable trouble. The president (Sir Bertram Windle) said one of the misfortunes of Ireland was that the people never really got a grip of the value of research.

A leading authority on electricity has written to the Dublin Press in protest against Sir Thos. Russell's attitude as closing the door to investigation. He points out that there are in Ireland 3,000,000 acres of fuel bog—a supply that would last for 1,000 years—and urges that if science could utilise these deposits it would not fail to provide a less primitive method of supplying the heat requirements of the peasant, who would readily understand that any great development of the country on commercial lines would develop him as well.

Electric Vehicles in Demand.—In view of the restricted supply of petrol, as a result of which a large number of motor-cars have had to be laid up, it is interesting to note that a demand is arising for electric vehicles, both new and second-hand. Thus, in one of the daily papers the other day, there appeared an announcement to the following effect:—"Electric vehicles; good prices given for modern cars in good condition, with or without batteries."

"Electric" Freemasonry.—On May 26th, at the installation meeting of the Electric Lodge, No. 2,087, at the Mitre Hotel, Hampton Court, Mr. W. E. Reid was installed in the chair as Worshipful Master by his predecessor, Mr. E. J. Willcock. Mr. Reid is the son of Mr. E. J. Reid (Reid Bros., Engineers, Ltd.), who celebrated the occasion by presenting the Lodge with a banner, bearing the names of all the Past Masters of the Lodge.

REVIEWS.

The Two-Stroke Engine. By A. M. Low, D.Sc. London: Temple Press, Ltd. Price 1s. 6d. net.

As a scientific investigator who cares nothing for established practice, Dr. Low's views on the subject of two-stroke engines are naturally of considerable interest. We do not expect any work of his to be a mere catalogue of what others have done. Rather do we look for originality and bold forecasting, as when he calls this type of engine "the coming form of internal-combustion engine." This statement of the author would seem to relate particularly to automobile engines, there being little or no reference made to stationary engines; thus he sketches out a fascinating design for a three-cylinder two-stroke light car which certainly ought to be given a trial, as such an engine would be as smooth running as a four-stroke six-cylinder. Whether it would be so efficient Dr. Low does not venture to say. It is true that the efficiency of the two-stroke engine can be raised until it almost equals that of the four-stroke, but this is achieved at the expense of that simplicity which is one of the greatest charms of the two-stroke design, necessitating the introduction of pumps and valves. The author blames prejudice for hindering the more rapid adoption of the two-stroke engine for motor work, but as long as the fuel consumption—a vital matter in these severely rationed days—of the simpler engine is proportionately so much greater that prejudice cannot possibly be dispelled. Here, and in other directions, is work for the designer. Admittedly the latter has been handicapped; thus we agree that "the vast majority of two-stroke engines would have been improved by a knowledge of indicator work on the part of their designers." Such knowledge, however, has been difficult to obtain, owing to the fact that with the exception of the magnetic and oscillating manograph—for the introduction of which we have to thank the ingenuity of Dr. Low—it is not practicable to obtain indicator diagrams at high speeds with any ordinary form of indicator. We can imagine how hopeless would be a card resulting from a run of a two-stroke engine doing its 6,000-8,000 revs. per minute! The mention of such speeds, which have actually been obtained, shows how nearly we are approaching to the internal-combustion turbine, as regards frequency of impulses, in the two-stroke engine; and this is one of the most interesting possibilities in front of the two-stroke engine.—G. S. S.

Gas, Oil, and Petrol Engines. By A. Garrard, Wh. Ex. London: Whittaker & Co. Price 5s. net.

To condense into 221 pages a "description of the construction and operation of the various types of internal-combustion engines" is a large order, bearing in mind the enormous advances that have been made in these engines of recent years. Clearly, there cannot be given in a work on these lines that perfection of detail that would appeal to the expert; nevertheless, the author has succeeded admirably in his main endeavour, which has been to enlighten not the cognoscenti, but the engineering student or apprentice and others engaged in engineering works or concerned in the running of internal-combustion engines. The account, inevitable in works of this class, of the "history and development" of these engines precedes chapters on general principles and fuel and combustion, all being commendably brief and to the point. This clears the way to a consideration, first, of gas engines, then of petrol engines, and finally of Diesel and oil engines. The general scheme of the author is, after giving a brief "introduction" to each class of prime mover, to describe a series of representative engines and fittings. Thus we are told—taking the first example from each class, so as to make no invidious distinction—about the Crossley engine, the Rudge-Whitworth motor-cycle engine, the four-stroke Diesel, and the Ruston-Proctor petroleum engine. The accounts of these and numerous other engines are quite well done, and are clearly illustrated by half-tone and line blocks. Chapters on gas producers, Humphrey explosion pumps and ignition complete a very useful little handbook.—G. S. S.

Elementary Strength of Materials. By Ewart S. Andrews. London: Chapman & Hall, Ltd. Price 4s. 6d. net.

Of works on strength of materials a fine assortment exists, but, generally speaking, they are of a costly, elaborate, and highly mathematical kind. Mr. Andrews's book is none of these. It is intelligible, thanks to the adoption of graphical methods, to all of average mathematical ability. Not merely students, but those engaged in practical designing work, will find the book of considerable service. The chapters on testing of materials are very helpful, giving as they do an outline of most of the well-known machines for testing materials. We miss, however, any reference to Prof. Dalby's work on this subject, though the automatic load-indicating machine devised by Profs. Dixon and Hummel is described and illustrated. The testing of concrete is interestingly dealt with by

the author, who is well known to building and architectural students. The book as a whole is one that we can heartily recommend to those desirous of investigating the elements of the subject, but for fuller treatment we must look to some more ambitious work, as, for example, the same author's larger work on strength of materials, of which the present is in the nature of an abridged edition.—G. S. S.

Engineering Workshop Drawing: First Steps in Engineering Drawing. By HENRY J. SPOONER. London: Longmans, Green & Co. Price 1s. 6d. net.

Prof. Spooner has given us a cheap and workmanlike book that cannot fail to be of value to all engaged in learning the elements of their profession in the engineering workshop courses of our technical institutes. Photographs are freely and wisely used to show how the various instruments should be handled, and these, combined with the 600 odd other illustrations, go to make up a really strikingly effective little handbook.—G. S. S.

A National System of Economics. By J. T. PEDDIE. University of London Press. Published by Hodder & Stoughton. Price 5s. net.

It goes without saying that a well-defined and preconceived system of economics is a national necessity—the difficulty is to say precisely what the system shall be. The present volume sets forth the results of the author's study of the problem, and this, in common with many other works on present and future economic problems, affords much food for thought. The whole question of national economics is, however, so broad and so involved that it is immensely difficult to make definite propositions. Yet these it is which are required, and probably to a greater extent now than at any previous time in our history, and we are not sure that at the present juncture the author would not have done better to start off with a statement of the 10 aims (which he now states on the last pages of the book), and base thereon definite proposals as to how they may best be attained—expressing his personal views as briefly as might be, and without copious quotations from the works of other writers.

We do not wish to belittle the present work, for it represents the fruit of much thought and labour, but we believe such a book as we suggest would be of greater national value. What we wish to do is to get our employers and our intelligent workpeople to formulate definite ideas on national economics as relating to their own work, and for the attainment of this end, the more concise and definite the proposals placed in their hands, the better. So much for our personal views, after expressing which it is only fair to outline the treatment which the author has given to his subject.

The first two chapters deal with considerations arising out of the Paris Economic Resolutions, and the conditions required to make those resolutions effective. Much useful matter is presented concerning the theory of free trade and protection and concerning enemy, allied, and neutral trade after the war. The inflation and manipulation of prices is next considered, together with the question as to whether, and how, London may remain the gold market of the world. The author's speculations are interesting and (so far as can be judged) sound, but fresh problems have been raised by America's entry into the war. In discussing the co-operation of Labour in production and politics, the author refutes the Marxian fallacies which have consciously or unconsciously been adopted by organised Labour in the past. The problem of securing sounder relations between Labour and Capital is one of the most serious with which we are faced, and the author's essay on the subject should contribute appreciably towards its solution. The same remark applies to the next chapter, on the economic aspect and problems of modern machinery. Here, again, the author upsets many Marxian views, and exposes facts which are all too often neglected by those who regard machinery as an instrument for robbing Labour of its just reward.

The author regards the minimum wage as the only solution to the Labour problem in general, and the best means of overcoming "restricted output" in particular. In the past it has unfortunately been the case that workers have demanded the proverbial yard when given an inch. However, the author's arguments are sound, and agree in principle with (though they perhaps exceed in optimism!) the views which we have expressed for years past. Chapter VII consists of a powerful plea for agricultural "revival," and an excellent explanation of the importance of agriculture; since these pages were written much has been done perforce which ought to have been done long ago, and surely the main lessons of national food production have now been driven home to us all. Chapter VIII deals with the equally important problem of reform in our transportation rates and methods. The advantages of a "clearing house" system are well explained. The final chapter deals with relative systems of political economy and national economics, and consists largely of an appreciation of List's work and the benefit derived therefrom by Germany. By the way, it is curious to find a statement in the preface that the author felt that his system of economics "rested upon a sure and solid foundation" only after he had read List's "National System of Political Economy."

We believe that this is the best book the author has yet produced. It deserves to be widely read and will amply repay careful study, and we hope that in due course the author will bring out a volume presenting exclusively his own constructive views in crystallised form.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Birthday Honours.—In the list of Birthday Honours conferred by the King, the following appear:—

Mr. H. Pike Pease, M.P., Assistant Postmaster-General, is made a Privy Councillor.

Sir Philip Magnus and Sir Robert Hadfield become baronets.

Mr. F. H. Barker, who has been interested in the development of the Parsons turbine; Mr. T. Gregory Foster, Provost of University College, London; Mr. J. A. F. Aspinall, general manager of the L. & Y. Rly.; and Dr. R. T. Glazebrook, C.B., of the National Physical Laboratory, and a Past-President of the I.E.E., receive the honour of Knighthood.

Central Station and Tramway Officials.—Mr. FAYLE, tramway traffic superintendent at Leyton, on leaving for a similar position at Southend-on-Sea, has been presented by the staff and employés of the Leyton U.D.C. tramways with a gold watch and chain.

Mr. R. ALLAN BROWN, who was appointed interim electrical engineer to Falkirk T.C. in September, 1915—on the occasion of the chief electrical engineer, Mr. Harold Ransom, joining the Inns of Court O.T.C.—and was later appointed to the charge post, has received a commission in the R.N.A.S., and leaves shortly for the Royal Naval College, at Greenwich. The vacancy, it is understood, will be temporarily filled.

The Glasgow T.C. is to consider the following increases of salaries recommended by the Tramways Committee:—Messrs. F. W. Christall, mains superintendent, from £365 to £380; J. Grierson, civil engineer, from £305 to £320; D. J. Liddell, outdoor traffic superintendent, from £325 to £340; R. F. Smith, accountant, £295 to £310; G. B. Masterton, chief draughtsman, from £295 to £310; John Crichton, cashier, from £270 to £285; and Miss J. Muir, lady superintendent, £230 to £245.

Mr. J. B. FELTHAM, electrical engineer to the Mexborough Urban Council, has been appointed engineer-in-charge of the waterworks recently acquired by the Council.

Belfast Corporation Tramways and Electricity Committee has appointed Mr. W. G. MOFFAT, chief engineer of the Belfast Rope Works Co., mechanical engineer at the Corporation electricity works.

Leek U.D.C. has appointed Mr. FREDK. SWARBRICK, of Minehead (Somerset), as chief electrical engineer, at £250 a year.

The services of Mr. TAPPER, borough electrical engineer, Stepney, have been requisitioned by the Government Coal Controller for assisting him in the apportioning of coal to electricity undertakings and other large users throughout the country. The Government will pay two-thirds salary, and Mr. Tapper will devote whatever time can be spared to the conduct of the Stepney undertaking.

General.—We regret to state that Mr. J. J. INGLIS, chief electrical engineer for Messrs. D. Colville & Sons, has just undergone an operation for appendicitis. We are glad to learn that the operation was very successful, and that Mr. Inglis is progressing favourably.

Mr. W. HAKES has been elected Chairman of the Hull Corporation Tramways Committee, and Mr. CHARLES RAINE has been elected deputy-chairman.

Colonel A. S. COOPER, C.M.G., has been appointed Director of Inland Waterways and Docks at the War Office, in succession to Major-General A. S. Collard, C.B., now Deputy Controller of Auxiliary Shipping at the Admiralty.

Roll of Honour.—Gunner E. BAWCUTT, R.F.A., formerly in the cable testing department of the India-Rubber Co., Silvertown, has been wounded in France.

Captain FREDERIC HANDS, R.E., formerly in the electric light department of the same company, was recently killed in France. He was son of Mr. Albert C. Hands, of Snow Hill, E.C. Captain Hands joined the Territorials as a sapper in the Electrical Engineers about 12 years ago. He went to France in October, 1914, with a Wireless Section, and remained there for about eight months, first as sergeant, and afterwards as sergeant-major. He then obtained his commission, and towards the end of 1915 was attached to the Air Lines, and last March obtained his captaincy. Captain Hands was Officer Commanding a Signal Constructional Corps, and he met his death returning late at night from an advanced post.

Private J. Barker, Loyal North Lancashire Regiment, missing since October last, now officially reported killed in action, was employed by Messrs. Dick, Kerr & Co., Ltd., Preston.

Lieutenant I. J. Clarke, of the Canadian Forces, who was killed in action on May 19th, aged 24, was in partnership with his brother in the Prince Albert Electrical Co. He emigrated to Canada several years ago.

Second-Lieutenant Harold Ransom, Argyle and Sutherland Highlanders, formerly chief electrical engineer under the Falkirk T.C., has been wounded in action, and is in a Manchester Hospital.

Lieutenant C. Maurice Down, 1st Hertfordshire Regiment, now attached R.F.C., has been awarded the Croix de Guerre. He has also been recommended for the Military Cross.

Sergeant John Dixon, who was employed in the tramways department of the Hull Corporation, has been awarded the Military Medal.

Staff-Sergeant George Marshall, R.E., who, prior to the war, was in the employment of the Dundee Electricity Works, has been mentioned in dispatches for good work done in France.

Wireless Operator Alfred Barrett Harwood is missing, and presumed drowned in the recent sinking of the *Arcadian*.

Lieutenant J. A. O'Sullivan, R.F.C., killed in action on May 27th, aged 20, was the only son of Mr. P. F. O'Sullivan, chief engineer of the Dublin United Tramways Co.

Corporal G. Cook, Essex Regiment, who has fallen in action, was with Messrs. Crompton & Co., Ltd., Chelmsford.

The Military Medal for bravery in action has been awarded to Private A. Shacklady, King's Liverpool Regiment, who was formerly on the staff of the St. Helens tramways.

Sergeant R. Greatorex, Chief Signaller, Border Regiment, formerly a driver on the Corporation tramways at Stockport, who gained the Military Medal for gallantry in action, has been presented with a lever watch by the Bredbury and Romiley Soldiers' and Sailors' Recognition Committee.

Private Colledge, formerly at the Rugby works of the B.T.H. Co., has been killed whilst dressing a wounded comrade in the open.

Corporal I. B. Lockhart, Cheshire Field Co., R.E., killed in action, was in the electrical engineering department of Lever Bros., Ltd., of Port Sunlight.

Sergeants J. Jackson and G. W. Jackson, brothers, who were both formerly inspectors in the Leeds Corporation electric lighting department, have died in hospital of wounds received in action on May 14th and 15th respectively.

Second-Lieutenant J. D. Ferguson, who was formerly on the staff of the Glasgow Corporation tramways department, after being officially reported missing on April 28th, is now announced to be a prisoner of war.

Private A. C. Pugh, aged 19, who was employed by the Kidderminster Electric Tramway Co., has been missing since April 28th.

Lance-Corporal R. Clifford, Sherwood Foresters, who was employed by the Electric Construction Co., Ltd., at Wolverhampton, has been killed in action.

Sergeant J. T. Deans, Army Cyclist Corps, who was killed in Palestine on April 19th, aged 23, was employed by Messrs. Chalmers, Ltd., electrical engineers, of Glasgow.

Private F. Walker, Canadian Mounted Rifles, previously missing, now reported killed, was employed at the British Westinghouse Co.'s works, Trafford Park.

Obituary.—Mr. Wm. Harpur.—We regret to record the death, at the age of 65 years, of Mr. William Harpur, city engineer of Cardiff.

NEW COMPANIES REGISTERED.

Cathodes, Ltd. (147,620).—Private company. Registered June 1st. Capital, £10,000 in £1 shares. Manufacturers and repairers of copper water jackets for internal-combustion engines, fuses, and other parts of shells, and similar articles, by electrolytic deposition, engineers, metallurgists, &c. Agreements (1) with C. E. Peczenik, (2) with N. Bosanquet, and (3) between Alastair-Houston-Boswall-Preston and T. Hamilton-Adams. The subscribers (each with one share) are: F. W. Darch, 20, Eastcheap, E.C. 3, solicitor; A. Taylor, Thames House, Queen Street Place, E.C., chartered accountant. The first directors are: T. Hamilton-Adams, N. Bosanquet, Sherard Cowper-Coles, Alastair-Houston-Boswall-Preston, and G. Houston-Boswall-Preston. Registered office: 11, Arundel Street, W.C. 2.

Renew Electric Lamp Co., Ltd. (147,598).—Private company. Registered May 31st. Capital £10,000 in 10s. shares (10,000 5 per per cent. cum. pref.). To take over the business carried on at 83, New Street, Kennington, S.E., as the Renew Electric Lamp Co., with F. Harrison and others. The subscribers (each with one pref. share) are: W. A. Ward-Jones, 7, Queen Street, E.C. 4, solicitor; T. J. M. Hume, 124, North View Road, Hornsey, N. 8, clerk. The first directors are: R. G. M. Delpech, one other to be nominated by him, and F. Harrison. Qualification, £100. Solicitors: Mawby, Mawby & Morris, 7, Queen Street, E.C. 4.

Geo. W. Baker, Ltd. (9,868).—Private company. Registered in Edinburgh on May 30th. Capital, £2,000 in £1 shares. Electrical engineers and manufacturers, &c. The subscribers (each with one share) are: G. W. Baker, 29, Kengraw Street, Glasgow; J. Smith, Machrihanish, hotel proprietor. The first directors are: G. W. Baker and J. Smith. Registered office: 19, Blythswood Square, Glasgow.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Tyne Electric Steel Foundries, Ltd.—Issue on May 10th, 1917, of £1,500 debentures, part of a series of which particulars have already been filed.

Tuke & Bell, Ltd.—Mortgage on proceeds of 16 munitions contracts, dated May 14th, 1917, to secure all moneys due or to become due from company to London City & Midland Bank.

Alert Electrical Co., Ltd. (78,971).—Capital, £2,000 in £1 shares. Return dated February 28th (filed May 5th), 1917. 708 shares taken up; £708 paid. Mortgages and charges: Nil.

CITY NOTES.

Metropolitan Electric Tramways, Ltd.

Revenue for 1916, £558,866. After including the balance brought forward from 1915, and deducting all expenses chargeable to revenue, including a provision of £22,158 for future reconstruction and renewels, £37,796 remains, out of which £11,015 is put to reserve, £25,000 is required for preference dividend, and £1,781 is to be carried forward. The traffic receipts, after adjustment of accounts with the L.C.C. in regard to through running services, amounted to £504,338, showing an increase of £43,515. This increase is more than swallowed up by the increase in working expenses. Passengers carried: 1916, 105,109,403; 1915, 89,656,054. Average receipt per passenger: 1916, 1.16d.; 1915, 1.23d. The units sold by the North Metropolitan Electrical Power Supply Co. were 53,352,819, as against 39,457,712 in the previous year. As a result of the abnormal cost of fuel, the gross profits of the Power Co. show a decrease of £4,081. Meeting: June 11th.

Electric Construction Co., Ltd.

Mr. P. E. Beachcroft presided at the annual meeting on May 31st. He said that the accounts again showed considerable improvement. The gross profit from manufacturing and contracting was £103,000, against £88,500, an increase of £14,500, and the net profit £51,500, against £43,200, an increase of £8,300. The increase in net profit was about 20 per cent., which, having regard to constantly increasing prices of all materials and higher rates of wages, was very satisfactory. Increases in wages were regulated by the Ministry of Munitions, and were generally put into operation with only short notice, but under existing conditions this might be unavoidable. As no corresponding increase, however, could be obtained on current contracts, they would realise how difficult it was nowadays to frame accurate estimates. For example, on April 1st an increase of 5s. per week was granted to all workmen, and a war bonus of 10 per cent. to the weekly staff. The work in progress on March 31st (which was greatly in excess of any previous year) would have to bear the full increase, and the estimated profit accruing for the new financial year would be somewhat reduced. It was to be hoped, therefore, that if and when further increases were granted, some opportunity would be afforded employers of completing current contracts on the old basis, or of being granted an increase in prices by Government departments on such contracts. For their improved results they were again indebted to a larger turnover. This having been obtained from substantially the same equipment as in pre-war times, very special exertions had been made by both the staff and workmen, for which they could not be too highly commended. The recent unrest in the engineering trade was non-existent in the company's shops, and their interest in the welfare of the men had been reciprocated by loyal and unremitting efforts on their part. The speaker said he concurred in the views expressed by many chairmen of public companies on the danger of appropriating so large a proportion of excess profits. The simplicity of the tax was of itself, of course, a great temptation, and to get as much as possible out of the taxpayer was presumed to be the duty of those who administered the Acts. Moreover, no corresponding duty had been imposed by Germany, where large sums were being accumulated by manufacturers, which would be utilised in capturing neutral markets. If any great expansion was to be made in the trade of this country, there must be a corresponding accumulation of capital, but how this was to be accomplished with so large a proportion of profits taxed at the source it was difficult to see. Regarding the business generally, their position gathered strength year by year, and he saw no reason why this should not continue. Much of their success was due to the amicable relations which had existed between the workpeople and themselves. They had endeavoured in every reasonable way to do what they could to contribute to their well-being and comfort, and many of the recommendations made by the Ministry had been in operation at Bushbury for some years. They had provided up-to-date recreation rooms, and ground for tennis and bowls,

and such facilities, he considered, were essential for the health and well-being of employés of all industrial concerns. Their clubs were well managed and controlled by the employés themselves, and were almost entirely self-supporting. The future of industrial development after the war was occupying the minds of all who had the welfare of the country at heart, and legislation must take account of future generations. The proper education and training of the young to take their part in that development were all-important, and technical school training should be compulsory. Wolverhampton, where their works were situated, had recognised its duty in this matter, and had provided excellent classes. For many years they had encouraged their boys to attend these technical classes, and successful students had been awarded prizes, and had been given promotion in the workshops. They had reintroduced the system of indentures, under which they hoped to turn out journeymen possessed of a greater degree of skill and knowledge of their trade, and in other respects were doing what they could to encourage and help the boys. Personally, he would like to see it made compulsory for factory boys to attend classes until they were, say, 18 years of age, and compulsory upon employers to give boys these facilities during business hours. This might somewhat disarrange the routine of workshops, but it would only be temporary; and would anyone deny that the advantage to the nation would not far outweigh any inconvenience or additional expense to the employer? The chairman expressed appreciation of the work of the managing director, Mr. Gray, the joint director and secretary, Mr. Willock, and the manager at the works, Mr. Furniss.

London and Suburban Traction Co., Ltd.

Revenue for 1916, £120,586, against £122,430 for 1915. Out of the total available balance of £84,857, the full dividend of 5 per cent. on the cum. pref. shares is paid, leaving £4,684 to be carried forward. The continuance of the war has adversely affected all the subsidiary companies owing to the large increase in the cost of labour and materials, but in the case of some of the companies the increased cost of operation has been largely met by an expansion of revenue. The position of the London United Tramways, Ltd., is referred to. Since the commencement of 1917 it has become evident that the net results for the year will be even less favourable. In these circumstances, and in view of the fact that a large sum will be required to put the undertaking into a proper condition of repair, a reorganisation of the capital of the L.U.T. appears unavoidable. Pending the formulation of a scheme for this purpose, proceedings have been commenced by a debenture stockholder of the L.U.T. for the appointment of a receiver. Until that scheme was settled, it was impossible to state how far the London & Suburban Co.'s interests in the company might be affected. No dividends have been paid by the L.U.T. since July, 1914, when ½ per cent. was paid on the preference shares. Meeting: June 13th.

Delhi Electric Tramways and Lighting Co., Ltd.

Gross receipts of tramway undertaking for 1916, £11,135; electricity supply undertaking, £22,934. These figures represent increases of 16 per cent. and 13½ per cent. respectively. Combined undertakings show a net revenue of £11,593, against £10,300 in 1915, and £8,163 in 1914. After charging general expenditure in London and Delhi, debenture and loan interest, Indian income-tax, and depreciation of profit and loss account, £3,194 remains, plus £896 brought forward. There is put to renewals reserve £1,000, 2 per cent. (less income-tax) is to be paid on the preferred shares, and £1,089 carried forward. Plant, equipment, and rolling stock have been overhauled, and are in good condition. Cost of upkeep will probably continue to be heavy for some time. Additions to plant during 1916 cost £1,856. The allocation from profits to meet depreciation of plant and equipment has been increased to £4,000, making the total £10,000. Further plant is imperatively necessary, and a contract for a third Diesel engine has been made. Arrangements have been made locally for the temporary use of an old machine. The provision of other necessary plant, equipment, and mains remains in abeyance for the present. Owing to these difficulties, and owing to the high prices of all materials, connections to new consumers are temporarily restricted, and charges for supply are increased.

London United Tramways, Ltd.

Gross receipts for 1916, £336,335 (increase £2,190). Increased cost of material and labour increased the expenses by £34,010. After including the balance brought forward, and deducting interest and all expenses chargeable to revenue, there is an adverse balance of £2,583 to carry forward to 1917. The report says:—"It has now become evident that the net results of operation in the current year will be even less favourable. In these circumstances, and in view of the fact that a large sum of money will be required for the purpose of placing the company's undertaking in a proper condition of repair, proceedings have been commenced by a debenture stockholder for the appointment of a receiver pending the preparation of a scheme for the reorganisation of the company's capital." As a result of further negotiations between the directors and the L.C.C., the litigation arising out of the arbitrator's award in the matter of the purchase of the company's tramways in Hammersmith, which form part of the security of the 4 per cent. first mortgage debenture stock, has been settled on terms which are set forth in the report, the purchase price being £235,000, completion to be postponed until the end of the war, and £12,000 towards the company's costs. The company may discontinue forthwith the generation of electricity at the Chiswick power station, and purchase the energy required for the Middlesex and London lines from the Lot's Road generating station, Chelsea, from which the current for the Surrey lines is already taken. The company may convert a portion of the power station into a transforming station, of which they will retain possession for 21 years in consideration of their giving the Council a free supply of electricity for a like period to the tramways to be taken over by the Council. Passengers carried were 65,734,446, as against 63,145,226 for 1915; car miles run 7,494,898, against 7,744,894 for 1915; average receipt per passenger 1.17d., against 1.21d. for 1915. Annual meeting: June 12th.

Callender's Cable and Construction Co., Ltd.

Presiding at the annual meeting, on Friday last, Sir J. FORTESCUE FLANNERY, Bart., M.P., said that during the war the course of all manufactures had been changed from the making of goods for the benefit of man to the making of implements for his destruction. Their manufactures had followed that unhappy downward course in an increasing degree each year since the war began. Whilst sparing no effort to serve the State, they had struggled hard to keep together their old and valued business connection which existed at home, in the Dominions, and in neutral foreign countries. They had had some success in that endeavour, and they had taken every precaution to enable them to open out again in their commercial connections when the war was over. In the meantime, the Minister of Munitions had imposed such restrictions as completely to change the ordinary course of their business. They had forbidden the use of copper for the making of cables, excepting those specially sanctioned for the war and for special purposes. The Minister of Shipping had restricted their export even of goods already made, and their foreign and colonial orders, the satisfactory execution of which would have redounded to the credit of the company, were now in a state of indefinite suspension. They had, however, not been without plenty of occupation, and the variety of the war munitions which they had taken in hand at the request both of the War Department and the Admiralty had been very great, and formed a monument to the mechanical ingenuity and the business adaptability of the managing director, Mr. T. O. Callender, and to his large and highly competent staff. Last year he mentioned how largely they had adopted the services of women, especially in their works in Lancashire. During the past year they had more women actually, and more in proportion than they ever had, and they were becoming more competent, capable, and satisfactory. They had had several substantial increases in the cost of labour as well as in the cost of materials. Since the last meeting they had opened a building which was intended for, and which was splendidly adapted to, every social and recreative use to which the employés could put it. It cost several thousands of pounds, and it had accommodation for seating nearly the whole of the employés at one time at meals, and at other times affording an opportunity for social meetings and recreation. They were constructing somewhat similar accommodation at the Erith works, while at Belvedere, quite close to their works on the Thames, they had a hostel which was intended for the living and sleeping of the female employés. They had already organised a system of "first aid" in case of accident or sudden illness, and they were endeavouring to extend that so as to have something more in the nature of hospital accommodation. The increase in wear and tear of plant had been considerable, because the plant had been working at high pressure all the time. They had enormously increased their output, and they had worked long hours. They had made such provision as seemed to be reasonable for depreciation. At both their Anchor works in Lancashire and their Erith factory they had put in quite a quantity of new and improved machinery. They had also increased the buildings very considerably, and at the moment they were constructing practically new works upon a portion of the land that the forethought of the directors had provided in years gone by. Having referred to the strengthening of the board by the election of Mr. A. W. Tait, the chairman proceeded to refer to the accounts. There was, he said, no change in the capital and the liabilities, in the reserve, or in the machinery renewal, but bills payable were £75,000 less than they were a year ago. That was one reflection of the shortage of commercial trade to which he had already referred. Their trade creditors and other liabilities were something like £159,000 more than they were last year: that was a reflection also of the change in regard to higher prices. On the other side of the balance sheet, the item for depreciation was £17,000—£7,000 more than a year ago, that being the very moderate assessment which they had put upon the extra depreciation to which he had drawn their attention. Cable drums, contract plant, &c., stood at £36,917, which was £4,000 less than a year ago, due to the fact that they had also depreciated those particular items on account of the extra service to which they had been put. The profits amounted to £190,000, as compared with £177,000 last year,

an increase of £13,000. That extra £13,000 profit was a very small increase in proportion to the labour and trouble required to earn it. They proposed to pay a dividend, which amounted with bonus and special bonus to a rate of 20 per cent., which would leave £249,000 to be carried forward. The 20 per cent. distribution, absorbing £35,000, was just one-seventh of the carry forward; in other words, they were being advised to carry forward an amount equivalent to a dividend of 20 per cent. for seven succeeding years. He did not promise them that dividend, and he did not know what to say about the future, which was very doubtful in all commercial enterprises, but it was a very fair, and even satisfactory, opening for the accounts for the new year. He would like to remind them that those very gratifying results had not been obtained by profiteering. They had not been paid excessive prices; they had made no unfair bargain out of the needs of the nation. They had changed their form of manufacture at the bidding of the State, and they had served the State for a reasonable and moderate remuneration. There had been no sensational increase in their profits; it was an honest profit largely based upon the accumulated savings of past years. If anybody should say that 20 per cent. was a high profit, the answer was that that profit had not all been earned in the year just closed, but that it was the result of the thrift, savings, and accumulations of many years past.

Mr. T. O. Callender, in seconding the motion, referred to the men who had joined the Forces, and to those who had laid down their lives. 678 men who formerly worked for them were now serving either in the Army or in the Navy. Under ordinary circumstances it was his custom to give them some information as to the new lines on which the business was progressing, and the new developments which were taking place. He was sorry that owing to the special nature of that business, and owing in many cases to the extremely confidential work they were doing, he could tell them but little. Most interesting work in various directions had been undertaken, but it was impossible in any way to specify what it had been. The ordinary run of their business in connection with the making of cables had practically ceased. It was impossible to obtain the necessary materials, copper being only one of them, and even if they could make cables it would be almost out of the question to get them to their destination. They recognised that when the war came to an end a good deal of work would be required to win back for the company the trade which had been lost through the necessary closing down of many of those old connections. Only a few days ago they received intimation that one of their friends in Scandinavia, who had been in the habit of making use of large quantities of their cables, had found it necessary to place their orders with a neighbouring country, and for the present, and, he was afraid, for some time to come, that market would be closed to them. While they recognised that those difficulties would arise, they were ready, when the war came to an end, to hold their own with any of their competitors, and to win back any part of their business which might have passed into other hands. They considered that although the success of the company had been considerable in the past, it was probable they would have a much larger and greater work to do in the future in the new England which would arise after the war. It was unquestionable that electricity would play a greater part in the daily life of man, and a much greater part in the manufacturing life of this country, than it had ever played in the past, and it was equally certain that, when that time came, Callender's would not be behind in obtaining a share of the orders which would result. They therefore anticipated a good deal of worry and a great deal of labour, but they hoped with satisfactory results, when the happy day arrived. They had spent large sums of money in the upkeep of the works; maintenance and depreciation had of necessity to be increased, for not only were the prices which they had to pay for materials infinitely greater than in past years, but the class of labour which they had to make use of was nearly always less experienced, and often less careful, than of yore, and as a result their plant and machinery, and tools and fittings suffered from the handling which they got. It was for those reasons that they had added so largely to depreciation.

The report was adopted.

United River Plate Telephone Co., Ltd.

Gross earnings for 1916, £709,226; gross maintenance and other charges in Argentina and London, £477,371; profit £231,855, plus £6,234 brought forward. After paying debenture interest, preference dividend, and 8 per cent., free of income-tax, on the ordinary shares, and putting £2,000 to staff provident fund, £50,000 to reserve, and £26,000 to war contingencies reserve fund, £6,990 remains to be carried forward. To fill vacancies caused by the death of Sir G. Franklin and Mr. G. Keith, Sir John Gavey has been elected chairman, and Messrs. J. E. Kingsbury and A. Anns directors.

Anderston Foundry Co., Ltd.—The report shows that the profit, after providing for depreciation, excess profits duty, and income-tax, was £32,767, against £30,329, before providing excess profits duty. Dividend for the year 22s. per share, putting £5,000 to reserve, and carrying forward £8,720.

Brazilian Traction, Light & Power Co., Ltd.—Quarterly dividend, 1½ per cent. on the fully-paid cumulative preference shares.

Calcutta Electric Supply Corporation, Ltd.—The units sold to consumers during the five weeks ended March 30th were 2,391,238, compared with 2,122,507 units last year.

Canadian General Electric Co., Ltd.—The directors have declared a quarterly dividend of 2 per cent. for the three months to June 30th, being at the rate of 8 per cent. per annum, on the common stock.

STOCKS AND SHARES.

Tuesday Evening.

The main feature of the markets throughout the House is the continued quietude of business. Russia has become something of a thorn in the financial flesh which threatens to be permanent; and with the rate of exchange daily moving against Petrograd, the investor, even in first-class British securities, is disposed to go slowly in the way of investing his money.

Meanwhile, authorities in high places are roundly rating us for our extravagance—and not us alone, but the Government also, for not taking away, by taxation, the means whereby extravagance is maintained. In spite, however, of this, with its appeal for more taxes, coupled with the quietude of business, prices of most investment issues are extremely well held. The electrical and the telegraph departments are excellent illustrations of this; and if proprietors of stocks and shares are tempted to complain that values do not improve, they have at least the consolation of seeing them keep remarkably steady.

Metropolitan Consolidated is ¼ better at 23¾, and Underground incomes are good at 83. This strength is shown in the face of weakness in most of the Steam stocks, the latter being unmoved by the fact that present prices include the greater part of the first half-year's dividends. Labour troubles—present and to come—are still the deterrent factors in the situation. Metropolitan surplus land stock is better at 49, and Districts are unchanged at 16. With the recent rearrangement of fares on the L.C.C. trams, the expectation is revived that fares on the Tube lines may be similarly treated before long.

Mexicans are mostly dull and heavy; the 5 per cent. bonds of the Tramway Co. have shed 2 points. Inquiries have been made during the last day or two on behalf of Amsterdam capitalists who appear to be anxious to take a hand once more in these ventures. The market, however, has drifted into such a limited condition that, while there is difficulty in getting a bid for stock one day, on the day following it may be just as hard to find a seller, so much are demand and supply governed by the immediate sentiment of the moment in regard to Mexico. If the Dutch started to buy Mexican industrials in earnest, prices would probably go bounding ahead; and holders of the stock on this side might welcome the opportunity for getting out, even at the big loss which most sales would entail.

Rio de Janeiro Tramway bonds are better, in consequence of a further rise in the Brazilian exchange; and for most of the Brazilian issues there is an increased demand, in which, however, Brazilian Tractions have not yet participated. The British Columbia group is still flat. Buyers want the offer of good-class Canadian industrials, more particularly those connected with the electrical industry; and the prospective purchasers announce that they are not out for high dividends, but that they are content with a comparatively low return on their money. Yet, so contrary are Stock Exchange currents nowadays, there is scarcely any stock to be bought; and whatever shares do come into the market are snapped up by people who have been waiting for weeks.

Anglo-Argentine Trams are dullish on the issue of the report, a document which shows that the undertaking is still struggling against adverse conditions. The second preference shares again go without their dividend. The Lisbon Electric Tramways increased its passengers by 10 milljons, but working expenses rose still more heavily, and the ordinary shareholders go dividendless, against the 4½ per cent. they received in the previous year.

Changes in the telegraph and telephone market are few and far between. West India and Panama Ordinary are left unchanged at 22s. 6d. ex the dividend of 6d., deducted last week, while Orientals at 2¼ show a nominal fall of 1/16, accounted for by the dividend of like amount. Amongst the stocks not quoted in our list, Amazon Telegraph were done the other day at 4 and 4 1/16. Cuba Submarine Preference changed hands at 14¼, and the last business done in Direct Spanish Preference was at 7¼. A little demand has arisen for the debenture stocks in this section, Eastern Extension Fours

being a point better at 74, while Eastern 4 per cent. Debenture is 73, the difference arising from the fact that the former stock carries about 10 weeks' more interest than the latter. West India and Panama first Preference were done at 7⅞ at the end of last week, but the Seconds have lain dormant since the beginning of April, the nominal price being 6, ex the recently-paid dividend. Monte Video Telephones are a little better at 17s. 6d., and the 5 per cent. Preference shares can be bought about 15s. 3d. The company pays 6 per cent. on the Ordinary shares.

The most active section is once more the Marconi market. The price spurted 3/16 to 3⅛, upon another wave of rumours in respect of the amount which the company is likely to receive from the Government. The dividend announcement is due almost immediately, and the report is eagerly anticipated in the hope that something will be said on the compensation question. With the parent shares the subsidiaries are also firmer, Marconi Marines being 2⅜ and the Americans 16s. 3d., although Canadians still languish at 9s. Marconi Preference have risen ⅛ to 2⅛.

India-Rubber shares are 5s. up, British Insulated 2s. 6d., and Telegraph Constructions 10s. British Aluminium ordinary rose 6d., and Castner-Kellner 1/16; in fact, the industrial market shows up much better than any other section of the House at present. Strong demand for shares in companies connected with explosives is explained by reports of a coming combine of the principal undertakings. Iron, coal, and steel shares have advanced substantially; armaments are better, and these various activities have diverted attention to some extent from rubber shares, where business has been further restricted by a slight fall in the price of the produce, which has taken it a shade below 3s. per lb.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1915.	Dividend 1916.	Price June 5, 1917.	Rise or fall this week.	Yield p.c.
HOME ELECTRICITY COMPANIES.					
Brompton Ordinary	10	9	6½	—	£8 18 6
Charing Cross Ordinary	5	5	3⅝	—	7 2 10
do. do. do. 4½ Pref.	4½	4½	3½	—	6 18 6
Chelsea	4	3	2¾	—	5 4 4
City of London	8	8	12	+ ½	6 13 4
do. do. 6 per cent. Pref.	6	6	10	—	6 0 0
County of London	7	7	10⅝	—	6 11 9
do. 6 per cent. Pref.	6	6	10	—	6 0 0
Kensington Ordinary	7	10	5½	—	5 11 7
London Electric	3	3	1	—	Nil
do. do. 6 per cent. Pref.	6	4	3½	—	5 6 8
Metropolitan	3	3	2¼	—	6 0 0
do. 4½ per cent. Pref.	4½	4½	3½	—	7 4 0
St. James' and Pall Mall	8	8	6⅞	+ ⅛	6 5 6
South London	5	5	2⅞	—	7 5 6
South Metropolitan Pref.	7	7	21/-	—	6 13 4
Westminster Ordinary	7	7	5½	—	6 1 9
TELEGRAPHS AND TELEPHONES.					
Anglo-Am. Tel. Pref.	6	6	£8	+ ½	6 2 0
do. Def.	33.6	1½	22½	—	6 13 4
Chile Telephone	8	8	6⅛	—	5 15 4
Cuba Sub. Ord.	5	5	8	—	6 5 0
Eastern Extension	8	8	18⅝	—	*5 17 6
Eastern Tel. Ord.	8	8	189	—	*5 15 1
Globe Tel. and T. Ord.	7	7	12½	—	*5 12 0
do. Pref.	6	6	10½	—	5 18 5
Great Northern Tel.	22	22	56½	—	6 0 7
Indo-European	13	13	49½	—	6 11 4
Marconi	10	10	3⅛	+ 3/16	3 4 0
New York Tel. 4½	4½	4½	99	—	4 11 0
Oriental Telephone Ord.	10	10	2½xd	—	4 14 1
United R. Plate Tel.	8	8	6⅝	—	*6 0 9
West India and Pan.	6d.	6d.	1½xd	+6d.	2 4 5
Western Telegraph	8	8	1⅛	—	*5 14 4
HOME RAILS.					
Central London, Ord. Assented	4	4	60½	—	6 8 0
Metropolitan	1	1	23⅜	+ ½	4 4 3
do. District	Nil	Nil	15	—	Nil
Underground Electric Ordinary	Nil	Nil	1⅜	—	Nil
do. do. "A"	Nil	Nil	5/8	—	Nil
do. do. Income	6	5	83	+1	*6 0 6
FOREIGN TRAMS, &c.					
	Dividend 1915.	Dividend 1916.			
Adelaide Sup. 6 per cent. Pref.	6	6	5	—	6 0 0
Anglo-Arg. Trams, First Pref.	5½	5½	3	— 1/16	9 3 4
do. 2nd Pref.	5½	—	2⅝	—	—
do. 5 Deb.	5	5	66xd	—	7 5 0
Brazil Tractions	4	4	47	—	Nil
Bombay Electric Pref.	6	6	10	—	6 0 0
British Columbia Elec. Ry. Pfce.	5	5	60	—	8 6 8
do. do. Preferred	Nil	Nil	37½	—	Nil
do. do. Deferred	Nil	Nil	32½	—	Nil
do. do. Deb.	4½	4½	58½	—1½	7 1 8
Mexico Trams 5 per cent. Bonds	Nil	Nil	38	—2	Nil
do. 6 per cent. Bonds	Nil	Nil	80	—	Nil
Mexican Light Common	Nil	Nil	14½	—	Nil
do. Pref.	Nil	Nil	21½	—	Nil
do. 1st Bonds	Nil	Nil	87½	—	—
MANUFACTURING COMPANIES.					
Babcock & Wilcox	15	15	23/-xd	—	4 18 0
British Aluminium Ord.	7	10	27/6	+6d.	7 6 10
British Insulated Ord.	17½	20	129	+ ½	7 18 5
British Westinghouse Pref.	7½	7½	2⅞	—	6 3 0
Callenders	20	20	15½	—	7 6 10
do. 5 Pref.	5	5	4	—	6 5 0
Castner-Kellner	22	22	8/-xd	+ 1/16	6 10 2
Edison Swan, £3 paid	—	—	3	—	Nil
do. do. fully paid	—	—	1⅝	—	Nil
do. do. 4 per cent. Deb.	4	4	70½	—	5 13 6
Electric Construction	7½	—	1	—	7 10 0
Gen. Elec. Pref.	6	6	9⅜	—	6 3 1
do. Ord.	10	10	15	—	6 13 4
Henley	25	25	15½	—	8 1 3
do. 4½ Pref.	4½	4½	4	—	5 12 6
India-Rubber	10	10	12½	+ ½	*8 5 0
Telegraph Con	20	20	87½	+ ½	*6 8 2

* Dividends paid free of income-tax.

MARKET QUOTATIONS.

IT should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Wednesday, June 6th.

CHEMICALS, &c.	Latest Price.	Fortnight's Inc. or Dec.
a Acid, Oxalic per lb.	1/6	..
a Ammoniac Sal per ton	£75	..
a Ammonia, Muriate (large crystal) "	£54	..
a Bisulphide of Carbon "	£23	..
a Borax "	£32	..
a Copper Sulphate "	£51 10	..
a Potash, Chlorate per lb.	2/6	..
a " Perchlorate "	2/-	..
a Shellac per cwt.	215/-	..
a Sulphate of Magnesia per ton	£16	..
a Sulphur, Sublimed Flowers "	£35	..
a " Lump "	£25	..
a Soda, Chlorate per lb.	10½d.	1½d. dec.
a " Crystals per ton	120/-	..
a Sodium Bichromate, casks per lb.	..	..
METALS, &c.		
c Brass (rolled metal 2' to 12' basis) per lb.	..	..
c " Tubes (solid drawn) "	..	..
c " Wire, basis "	..	..
c Copper Tubes (solid drawn) "	1/8½ to 1/9	..
g " Bars (best selected) per ton	£165	..
g " Sheet "	£165	..
g " Rod "	£165	..
d " (Electrolytic) Bars "	£142	..
d " " Sheets "	£167	..
d " " Wire Rods "	£150	..
d " " H.C. Wire per lb.	1/5½	..
f Ebonite Rod "	8/-	..
f " Sheet "	2/6	..
n German Silver Wire "	2/3	..
h Gutta-percha, fine "	6/10	..
h India-rubber, Para fine "	3/3	1d. inc.
i Iron Pig (Cleveland warrants) per ton	Nom.	..
l " Wire, galv. No. 8, P.O. qual. "	£10	..
g Lead, English Pig "	..	..
g Mercury per bot.	Nom.	..
e Mica (in original cases) small per lb.	6d. to 8/-	..
e " " " medium "	3/6 to 6/-	..
e " " " large "	7/6 to 14/- & up.	..
d Silicium Bronze Wire per lb.	1/0½	..
r Steel, Magnet, in bars per ton	..	..
g Tin, Block (English) "	..	..
n " Wire, Nos. 1 to 16 per lb.	3/6	..

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
r W. F. Dennis & Co.

Ministry of Munitions and Insulated Wires and Cables.—Revised regulations have been issued by the Ministry of Munitions as to the manufacture and supply of insulated electric wires and cables. Under these regulations, dated June 1st, 1917, the exemption from the terms of the Copper Order, dated December 8th, 1916, under which wires and cables of small size used for interior wiring could be manufactured and supplied outside of the terms of the order has been withdrawn. As from the above-mentioned date consumers not entitled to Priority Certificates Class A and Class B (P5) may obtain supplies of insulated copper wire without a priority certificate, provided that they are able to satisfy the manufacturer or supplier that the goods are to be used solely for the purposes of repairs and maintenance. The Cable Makers' Association, Sardinia House, Sardinia Street, Kingsway, W.C. 2, has been granted permission to obtain a limited monthly supply of copper for distribution among manufacturers, whether they be members of the Association or not, for the purpose of manufacturing insulated wires required for repairs or maintenance. The Association has been appointed the controlling authority, and is held responsible for the distribution of this monthly ration of copper.

Manufacturers requiring copper for this purpose should apply to the Cable Makers' Association at the address given above. The regulations provide that in respect of new orders, existing stocks of insulated copper wire may be used only for repairs and maintenance, unless required for a Government contract, or for work covered by a Class A or P5 Priority Permit. Copies of the regulations may be obtained from the Ministry of Munitions, Priority Department, 1, Caxton Street, Westminster, S.W. 1.

Platinum Production in the Urals.—In spite of the present high prices for platinum, the production of the metal in the Urals during 1916 showed a further decrease. The total output, according to a report from H.M. Consul at Ekaterinburg, amounted to 86,508 oz., as compared with 118,709 oz. in 1915, and 156,755 oz. in 1914. The chief causes of this decline are the shortage of labour, the difficulty in obtaining spare parts for dredgers, and the exhaustion of the richer alluvial deposits. It is confidently expected that new alluvia will be found when extensive prospecting is resumed, but there is no prospect of an improvement in platinum production in the near future, at any rate, as long as the war lasts; on the contrary, it is probable that the output for 1917 will be lower than that of last year.—*Journal of the Royal Society of Arts.*

EXPORTS AND IMPORTS OF ELECTRICAL GOODS DURING MARCH AND APRIL, 1917.

For reasons which we must leave to the imagination of our readers, the usual Customs returns on which our monthly table of electrical exports from and imports into the United Kingdom are based are no longer available, and it has been necessary to consider the question of publishing such data as can be obtained, with a view to preserving what has undoubtedly been a much appreciated feature of the Electrical Review for many years past.

Although interesting at the moment, no doubt, to commercial men, the comprehensive data published by us since the commencement of the war, and especially in recent months, in view of present overseas trade conditions, are probably not representative of what may be anticipated after the war when trade conditions resume more normal channels, and the condensed returns, obtained from official sources, which we are now able to publish, although not entirely comparable with our previous returns, will, no doubt, serve the purpose of keeping our readers to some extent informed on this branch of industry under war conditions.

The last complete return of electrical exports and imports, for February, appeared in our issue of March 30th last, the totals for the month as computed from Customs statistics being as follows:—Exports, £394,062; imports, £183,192; re-exports, £31,445.

The returns for March and April, which are compiled on a slightly different basis, are given below.

It should be noted that the values of electrical wire and cable include for insulated varieties only; it may also be observed that our previous returns have almost always shown a value of machinery exported in excess of that imported, and the departure from this in the above returns may be due to differences of classification, of which, of course, we have no details.

It will be noted that while the value of the March electrical exports was rather in excess of that of the previous month, the April total shows a marked decrease; also that both the March and April imports totals were considerably in advance of the February figures, though the later month showed a decrease of £50,000 on the March return.

Electrical goods and apparatus unenumerated.	Insulated wire and cable (not telegraphic or telephonic).	Electric glow lamps.	Arc lamps and parts (not carbons).	Meters and instruments.	Electrical machinery (including switchboards and transformers).	Batteries.	Carbons.	Telegraph and telephone wire and apparatus.
Exports of Electrical Goods and Machinery, March, 1917.								
£67,328	£68,256	£16,110	£7,004	£11,973	£117,877	£16,071	£1,942	£98,025
Total ... ... £404,586.								
Imports of Electrical Goods and Machinery, March, 1917.								
£53,041	£7,504	£24,356	£8,568	£2,131	£151,527	£24,919	£9,244	£5,631
Total ... ... £286,921.								
Exports of Electrical Goods and Machinery, April, 1917.								
£52,574	£18,403	£8,843	£4,591	£6,349	£92,068	£10,611	£1,312	£113,763
Total ... ... £308,514.								
Imports of Electrical Goods and Machinery, April, 1917.								
£48,090	£2,266	£4,674	£10,645	£596	£129,808	£27,071	£9,128	£3,707
Total ... ... £235,985.								

A CONCENTRIC STANDARD DYNAMOMETER WATTMETER AND NON-INDUCTIVE STANDARDS OF LOW RESISTANCE.

By A. E. MOORE, A.M.I.E.E.

(*Abstract from the "Journal" of the* Institution of Electrical Engineers.)

The object of much of the work outlined in this paper was to provide, in the Standardising Laboratory at the School of Technology, Manchester, a precision watt standard for dealing with load currents of upwards of 1,000 amperes. The instrument was to be suitable for the verification of sub-standard and other wattmeters and watt-hour meters, and for any other refined measurements where accuracy is of first importance. A Duddell-Mather standard was installed in the Laboratory originally, but an instrument of this type was not, at that time, made for currents higher than 100 amperes. The requirements of the Laboratory frequently called for an instrument capable of dealing with currents much higher than 100 amperes, and a Kelvin watt balance for currents up to 1,000 amperes was afterwards obtained. Previous to the installation of the 1,000-ampere balance, a composite balance was used as the watt standard for currents of from 100 to 500 amperes, but investigation showed that neither of these balances fulfilled the necessary requirements.

It is now fairly well known that many of the so-called standard dynamometer wattmeters of the straight-through type designed for currents exceeding 100 amperes are unsatisfactory except for use on circuits of approximately unity power factor. The defects are mainly due to eddy currents and skin effect. Eddy currents in the metal forming the main conductors, and in any other metal-work used in the construction of the instruments, cause the active part of the flux in the main-current coil to be out of phase with the main current, while the skin-effect may cause variations in the distribution of the current over the cross-section of the main conductors with changes in frequency, and this may consequently affect both the magnitude and the phase of the active part of the main-coil flux. It should be remembered that the active conductors of the pressure coil cannot be made to embrace more than a small portion of the main-coil flux, and for successful working this portion must always be a definite fraction of, and in the same phase as, the whole flux. It is not very difficult to eliminate eddy-currents by avoiding the use of metal supports, &c., and having the main coils formed of stranded conductors, each strand being insulated; but in order that the current distribution may be maintained constant independently of changes in the frequency of the current, it is necessary that every strand of the conductor have the same time-constant (L/R). In the ordinary form of dynamometer wattmeter the main-current conductor is in the form of a coil of one or more turns, and there are many difficulties in the way of the satisfactory stranding of the conductor, if it is intended for currents of upwards of 1,000 amperes.

The present contribution deals with a form of wattmeter in which the theoretical conditions are maintained in instruments for currents of upwards of 1,000 amperes.

In the wattmeter now to be described the author has made use of the concentric magnetic field which is formed between two concentric conductors when a current is maintained in them in opposite directions.

If a wire be wound uniformly over the surface of a ring as shown in fig. 1, the magnetic field produced when a current is maintained in the wire is symmetrical about the principal axis of the ring, so that every turn of the wire encloses the same magnetic flux, and, presumably, has the same ohmic resistance, and therefore the same time-constant. If all the turns are cut and their ends securely connected to copper end-plates (fig. 2), the turns will be connected in parallel instead of in series, and the time-constant of any one turn will still remain the same as that of every other turn, since each will be of the same resistance and will embrace the same flux. Therefore, if an alternating current be maintained in the coil thus formed it will be uniformly distributed over the turns, and the uniform distribution of the current will be unaffected by changes in the frequency. It is imperative that the winding be perfectly symmetrical, and in making up an actual coil many difficulties had to be overcome before a satisfactory construction was obtained.

Fig. 3 illustrates how the pressure coils may be arranged within the current coil. Two coils are used in order to render the system astatic to uniform stray magnetic fields. The magnetic axes of the pressure coils are nominally perpendicular to the direction of the flux produced in the main coil, and the result is a turning moment about a vertical axis.

The difficulties met with in the production of a concentric-field wattmeter are:—

1. The construction of a current coil in which the phase difference between the flux and the current that produces it is negligibly small.

2. The making of a mechanical joint in the current coil,

which permits of the easy insertion of the pressure coils, but does not introduce a phase error in the current coil.

3. The design and construction of the most suitable form of pressure coils.

In the paper are given descriptions of the various models with which the author experimented, and the defects found in them.

Difficulty was experienced in eliminating the phase difference between the flux and the current. Slight inequalities in resistance, especially at soldered and brazed joints, were ultimately found to be responsible for this trouble, and by adopting a design in which the current element takes the form of a cage consisting of wires soldered into heavy brass end-plates ½ in. thick, connected to concentric tubular conductors, the phase error was reduced to less than one minute of arc (actually 0.0002 radian).

The heating of the inner conductor limits the current-carrying capacity of the coil; the element described will carry 1,500 amperes for a short time without undue heating, but in the reflecting type of instrument, to prevent trouble due to convection currents of air, a stream of water is passed through the inner tube. Fig. 4 shows an element made on this principle, with a mechanical joint at G, which enables access to be obtained to the interior of the cage.

In a future construction it is intended to make the joint in the middle of the cage, as shown in fig. 5. In this case it is not necessary to have the pressure coils of a form which can be passed between the wires of the case or through the ring R. This being so, a continuous tube or "shell" may be substituted for the "cage."

The pressure coils were at first mounted on ebonite bobbins, but after the jointed cage was made they were mounted on a mica disk, which was found lacking in rigidity. The form of coil finally adopted is shown in fig. 6. It consists of two D-shaped coils, each of 100 turns of No. 36 S.W.G. silk-covered copper wire, mounted in an ebonite ring; the movement weighs 36.5 gm., and the inductance of the two coils in series is 2.3 millihenries. An oil-damping vane is provided.

By modifying the ratio of the width of space between the coils (a) to the length of the straight side of the coil (l), it was found that when $l = 1.73\ a$, the torque was almost independent of the angular relation between the magnetic axes of the main and movable coils over a range of 80 deg. to 90 deg.

Comparative tests made between the concentric wattmeter and a Duddell-Mather standard wattmeter show that the phases of the fluxes in the two instruments are in exact agreement when the watts are zero and the volt-amperes 10,000, at 50 cycles. Observations were also made at various power factors, leading and lagging, and when corrections were made for lag in the pressure coils the two instruments agreed as nearly as they could be read, the ratio of the deflections remaining constant and independent of the power factor. On increasing the resistances of the pressure-coil circuits so that the error due to lag was negligible, and making comparisons from 0.95 to zero power factor, the indications of the instruments without corrections agreed at all power factors as nearly as they could be read.

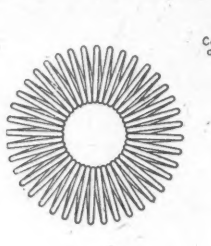


FIG. 1.—CLOSED RING WINDING

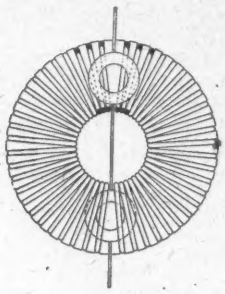


FIG. 2.—SECTIONAL VIEW SHOWING HOW TURNS OF RING WINDING MAY BE ARRANGED IN PARALLEL. TWO TURNS ONLY SHOWN.

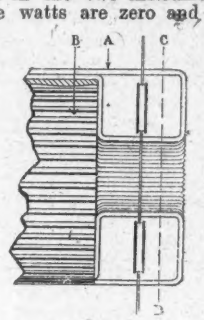
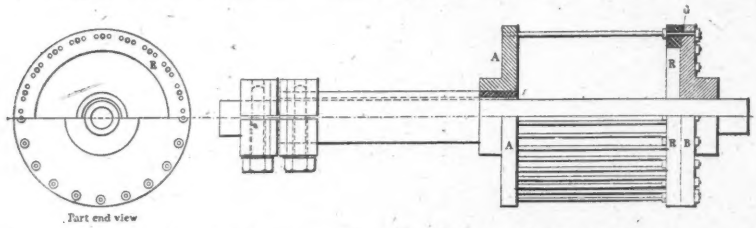


FIG. 3.—CURRENT ELEMENT FOR CONCENTRIC WATTMETER, MADE UP OF FORMED COILS A MOUNTED ON A SLOTTED WOODEN CYLINDER B.

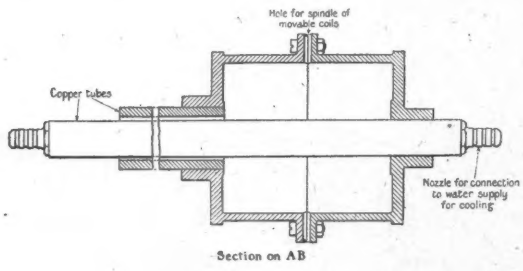


A, B, end-plates; R, brass ring; G, machined joint.

FIG. 4.—IMPROVED CAGE FORM OF CURRENT ELEMENT, WITH MECHANICAL JOINT.

As at present used, the reflecting concentric instrument is calibrated with a single D.C. current measurement at or near a fixed deflection, the resistance in the pressure-coil circuit being varied to give the desired deflection. By adopting this method of constant deflection the necessity for drawing out a correctly divided scale is avoided, the accuracy of reading is constant, the work entailed in verifying the constant of the instrument is reduced to a minimum, and, in the event of its being necessary to disturb the position of the instrument or the scale, the new constant is readily determined.

The instrument is arranged with a standard resistance of 0.001 ohm, as a shunted-type dynamometer ammeter, the connections being as indicated in fig. 7. The pressure coil is connected in series with a non-inductive resistance so that the total resistance r of the pressure-coil circuit is 500 ohms. A continuous current is maintained in the main circuit, and is adjusted until the required deflection d is obtained on the wattmeter scale. The current is measured by means of a potentiometer connected to the 0.001-ohm resistance strip.



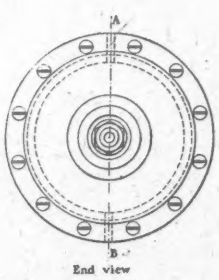


FIG. 5.—CURRENT ELEMENT WITH OUTER CONDUCTOR FORMED OF A SHELL CAST IN HALVES.

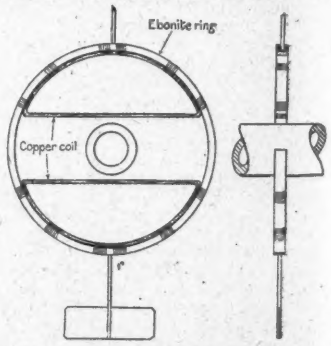


FIG. 6.—D-SHAPED COILS IN EBONITE RING.

Then if k = the watts per division of the scale for a pressure-coil resistance of 1 ohm, watts indicated by instrument = $k\,r\,d$. If the resistance r is chosen so that the desired deflection is produced with a potential difference at the terminals of the resistance R about equal to that of a standard cadmium cell (*i.e.*, a current of 1,000 amperes if R = 0.001 ohm), certain possible errors in the potentiometer are eliminated. The potentiometer, as such, is in fact quite unnecessary when the above conditions obtain, and the author is arranging the testing circuit as indicated by the dotted lines in fig. 7. In this case the main current is adjusted until the potential

difference on the resistance R exactly balances the electromotive force of the standard cell. The resistance r is then varied until the required deflection is obtained.

With r = 500 ohms the temperature coefficient of resistance of the pressure-coil circuit is less than 0.02 per cent. per deg. C.

In good dynamometer wattmeters designed to give a full-scale deflection with full-load volts, full-load amperes, and unity power factor, it is generally hardly necessary to make corrections for the phase lag in the pressure coils, even when the instrument is used on low power factors.

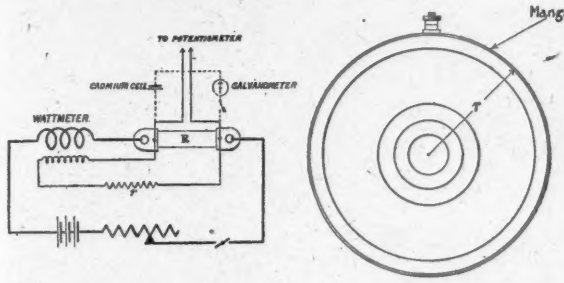


FIG. 7.—CONNECTIONS FOR CALIBRATION OF DYNAMOMETER.

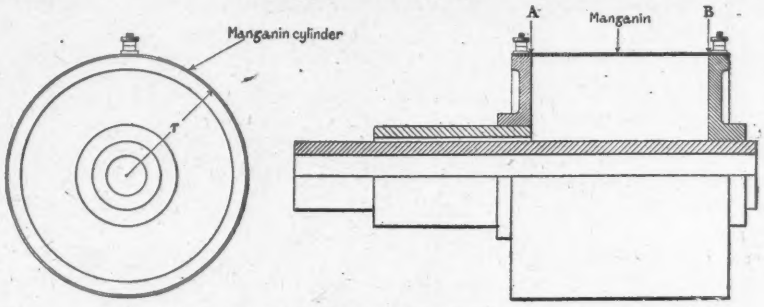


FIG. 8.—NON-INDUCTIVE LOW-RESISTANCE STANDARD.

It must not be assumed, however, that all the instruments so calibrated are free from measurable errors at low power factors. There are, in some types, serious errors due, not to the phase lag in the pressure coil, but to the other disturbances referred to in this paper.

When the wattmeter is connected up for calibration as described above, it becomes a shunted type dynamometer ammeter, and can be used as such, the current in amperes being

$$\sqrt{(kdr/R)}.$$

If a cylinder of resistance alloy be substituted for the wires forming the outer conductor of the wattmeter cage as in fig. 8, a non-inductive, low-resistance tube is obtained. If the thickness of the resistance alloy were indefinitely small the inductance of the tube would be zero whatever the length of the tube. For finite thicknesses of the material the inductance is calculable, and may be made very small.

An evenly distributed entry of the current into the resistance material is essential in standard resistances, and particularly so in non-inductive types, and the arrangement of the concentric connections shown in fig. 8 appears to be the most effective way of ensuring this.

The author gives details of tests made with a view to the construction of a polyphase standard wattmeter, a scheme of connection for testing such instruments, and an accurate method of measuring small differences of phase by comparing both of the currents whose phase difference is under examination with a third current of the same frequency. In an appendix the torque obtainable with different shapes of pressure coils is analytically discussed.

REINFORCED CONCRETE TRANSMISSION POLES.

A RECENT issue of *Indian Industries and Power* contained a contributed article describing the experimental ferro-concrete poles which have been produced by the Military Works Services at Lahore. Both solid and hollow poles were tried, of varying mixture and percentage reinforcement, a fairly rich aggregate being ultimately adopted. The best results for ballast were obtained with limestone broken to pass through a ½-in. sieve; good results were also obtained with a mixture of crushed pebbles. The reinforcement comprised ½-in. square rods braced laterally at 1-ft. intervals with ¼-in. diam. rods, which were welded to make them continuous.

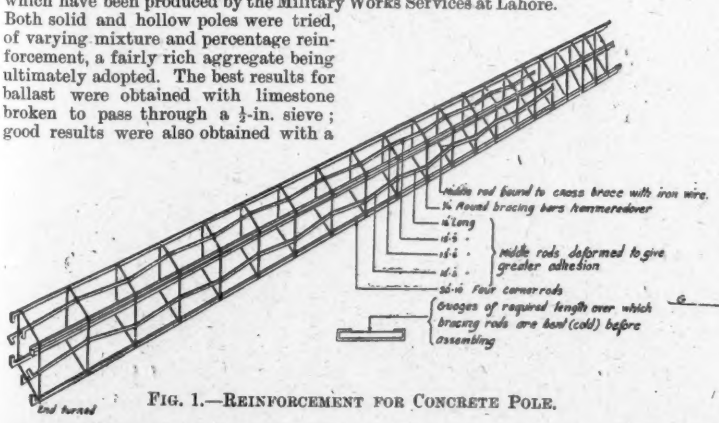

middle rod bound to cross brace with iron wire.
¼ Round bracing bars hammered over
11' long
11' 6"
11' 6"
11' 6"
middle rods deformed to give greater adhesion
Four corner rods
Gauges of required length over which bracing rods are bent (cold) before assembling
End turned

FIG. 1.—REINFORCEMENT FOR CONCRETE POLE.

All ironwork was cut to gauge, and ends of cross-braces bent over the gauge, thus ensuring correct spacing and rapid assembling.

Most poles have four full-length corner rods and four intermediate side rods to a point about half way up the pole, these rods terminating at intervals of 3 in. to avoid a sudden change in the percentage of reinforcement, and being deformed to give greater adhesion; the ends were also turned in to avoid any movement when under tension. An earthing wire was carried down inside the concrete, and bound to each vertical rod to obviate any chance of electrolysis, tails being left out to earth cross-arms, &c. The street poles are 31 ft. long, 10 in. sq. at the bottom, and 6 in. sq. at the top; the 29-ft. poles are 9 in. and 5 in. sq. respectively. Both these poles have been used in pairs as H poles.

The method of casting the poles is as follows:—A number of sleepers are laid in the ground, tops flush with the ground level, six rows parallel with each other at 5 ft. apart. Across each sleeper three bottoms are securely fastened, wooden chocks being fixed to each sleeper 3 in. clear of the bottom boards, against which the sides are wedged when required for casting. To each set of three bottoms one pair of sides are provided, and this constitutes a unit for turning out one pole a day. The first day the sides are wedged up to No. 1 bottom and the pole cast; the following day the sides are taken off and put up to the second bottom, and that pole cast, and similarly for the third day; on the fourth day the pole on No. 1 bottom is pulled off endwise on to level ground, and the cycle of operations repeated.

This system was adopted for both solid and hollow poles, though the extra labour involved in the hollow poles made their advantage over the solid ones rather doubtful, except as regards weight.

To obtain a hollow core, if desired, a hollow tapering steel tube, flush riveted, is placed inside the mould, small concrete saddles supporting it at each end and the middle; this protrudes at the small end 2 ft., and, after the concrete has been in six hours, is tapped back flush at the small end to relieve it from the concrete. It is soft-soaped prior to casting, and withdrawn the next day. The moulds are smooth inside and whitewashed; fillets are inserted at the corners to bevel the poles.

The constituents, including the water in the concrete, were carefully measured, and it was made slightly wet to facilitate casting; with solid poles, 2 in. of concrete was first laid in, and the reinforcement laid on that, the mould being then filled up.

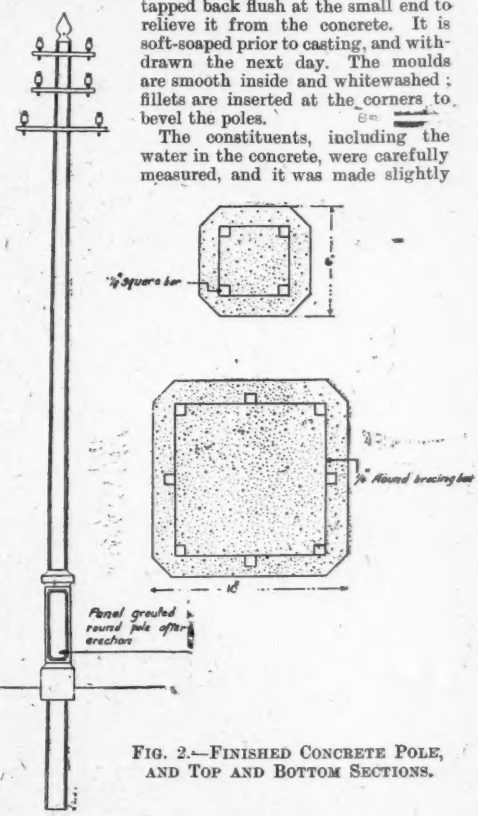


FIG. 2.—FINISHED CONCRETE POLE, AND TOP AND BOTTOM SECTIONS.

After casting, the poles were kept covered with damp straw and gunny bags for three weeks, dried out for a week, and erected when a month old. Ordinary methods of carrying and erecting were employed; the root of the pole was set 5 ft. in the ground on 6 in. of lime concrete, with another foot of concrete rammed round the end after erection.

Ordinary methods of staying were adopted in line construction; in some cases the sizes of feeders ranged up to 3/0 B & S.

No cement was used having an initial setting time under 60 min., the casting of one pole taking about 45 min. The poles have been made both departmentally and by contract, the cost at the present time being Rs. 50, including cement at Rs. 81 per ton and steel rods at Rs. 28 per cwt. At pre-war prices the costs might be reduced to Rs. 20 per pole.

THE IMPORTANCE OF HYGIENIC FACTORY CONDITIONS.

IT is not possible with any degree of exactness to calculate the influence that hygienic conditions have with regard to output. That they have a great influence is generally acknowledged. There is a growing conciousness that the hours of labour and the rate of wages paid are not the only factors that determine the amount of production. More than food and rest are necessary to make the worker physically healthy, and unless he is healthy in body his thinking capacity will be diminished, and he will be a less valuable asset to the State and to his employer than he ought to be. The amount of lost time is usually attributable, in a lesser or greater degree, to the effect of working in a germ-laden atmosphere, and it is to the mutual benefit of both man and master if the factory is wholesome. It is obviously unfair, as is sometimes done, to blame the factory-owner altogether for the conditions of the shop. The workman must share the blame. Most men are dual personalities. It is a curious psychological fact that men spend about equal time at work and at home, yet, unless in rare cases, the habits of the one life do not influence the other. The customs that are considered common decency in the home are not observed at work. The laws of cleanliness are neglected. Workmen expectorate freely on the shop floor, or wherever is most convenient, tea dregs are thrown about, oil is spilt carelessly, and dirt of all kinds is left lying about the machine or the bench. Of course, the habits of the men are influenced to a considerable degree by the conditions for which the employer is responsible. A new building may be always healthier than an old one, and a great many works want rebuilding; but a clean old building is a preferable place to a dirty new one. If floors are not swept daily, or several times a day, depending upon the operations performed in the shop, it seems futile to be careful of them. There is always a greater inducement to be clean in a parlour than in a stable. A great deal depends upon shop discipline. It is a fact that many foremen are so much interested in the skilled workers' efforts that they have not time to look after the labourers. The labourers are thus allowed a free hand, and it appears to be human, that unless a man is subject to supervision he gets lazy. Dust is allowed to accumulate in corners and on girders for a whole 12 months. The annual shop cleaning is quite a customary affair, but in some cases the dust and filth of all kinds are allowed to lie for years. It is admittedly difficult in machine shops with continually revolving shafts to clean in working hours. Some provision, however, ought to be made for having it done after the ordinary working hours or at the week-end. In many shops the windows get literally blocked up with dirt, and are never opened either in winter or summer. The work is carried on in a nauseous, unhealthy atmosphere, and towards the close of the day there is a general state of fatigue, and work slackens. Good ventilation is necessary to big output.

Many workmen do not leave the shops even during meal hours. They sit on dirty benches or on machine tables and eat their meals. It is quite a common sight to see a group of men huddled round a smithy fire, or in a foundry stove, eating breakfast or dinner, and drinking black tea out of blacker cans. Even when dining-halls are provided, they are not universally used. One cause of this is probably that there is not the same privacy sitting at a long table in a crowded dining-hall; but the chief cause, perhaps, is that the workman cannot be bothered with going out of his shop. It is an attitude of mind based on habit, and not easily broken. Most of us are conservative at heart, and do not like to be deprived of what we have come to regard as rights, and not privileges. The only way to get workmen into the dining-hall habit is to close the shops during meal hours. It would well repay all employers to have dining-rooms, where the workers could either have meals at a nominal price, or have their own food cooked.

It is a pity that some workmen so often spoil a beneficent employer's endeavours by loitering, and in other ways slacking. In many industries wash-hand basins are now enforced by law, and employers generally would, no doubt, provide better facilities for washing and dressing if it were not for the precautions they find it necessary to take against unprincipled workmen. These are not in the majority, however, and the man and the master ought to recognise a mutual interest in raising the level of the factory to that of the home.—*Mechanical World.*

NEW PATENTS APPLIED FOR, 1917.

(NOT YET PUBLISHED).

Compiled expressly for this journal by MESSRS. W. P. THOMPSON & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

7,329. "Electrodes." A. B. PESCATORE. May 21st.
7,337. "Loading coils for telephone circuits." G. E. BAIRSTO, BRITISH INSULATED & HELSBY CABLES, LTD., AND H. H. HARRISON. May 21st.
7,354. "Self-regulating dynamo-electric machines." B. BROOKS & W. HOLT. May 22nd.
7,360. "Electrical accumulators." J. MURDOCH. May 22nd.
7,368. "Electric couplings." H. E. CATO & SOPWITH AVIATION CO. May 22nd.
7,372 and 7,373. "Electric controllers, &c." J. ANDERSON & G. ELLISON. May 22nd.
7,388. "Detachable watertight terminals for electric cables." G. F. COOKE. May 22nd.
7,400. "Anodes for electro-deposition." A. S. LUCAS. May 23rd.
7,403. "Insulators for supporting overhead electric conductors." H. R. LAMB. May 23rd.
7,427. "Wireless telegraphic apparatus." BRITISH THOMSON-HOUSTON CO. General Electric Co., U.S.A.). May 23rd.
7,430. "Four-stroke-cycle explosion or internal-combustion motors with magnetic ignition apparatus." C. A. HULT & O. W. HULT. May 23rd.
7,431. "Apparatus for electric light and power distribution." W. J. FURSE & CO. AND R. W. WILLIS. May 23rd.
7,432. "Manufacture of glass lenses of electric torches, &c." T. DAVIDSON. May 23rd.
7,442. "Electrically welding rims or flanges of wheel tires." R. KRONENBERG. May 23rd.
7,444. "Magnetometers for measuring weak magnetic fields." J. L. VALENTE DA CRUZ. May 23rd.
7,449. "Sparking plugs for internal-combustion engines." T. H. R. KEY. May 23rd.
7,450. "Incandescent lamp sockets." J. S. WITHERS (Levy). May 23rd.
7,461. "Electrical water-heating apparatus." J. F. BARR. May 24th.
7,484. "Adjustable brackets for gas, electric, &c., lamps." T. W. STYLES. May 24th.
7,487. "Electric cables." A. PAXTON. May 24th.
7,499. "Electrical ignition systems for internal-combustion engines." E. HARRISON. May 24th.
7,505. "Electric alternators." E. C. DIEM. May 24th. (France, May 23rd, 1914.)
7,510. "Electric flat-irons." C. S. PALMER & D. PALMER. May 24th.
7,519. "Means for preventing oxidation or wasting of electrodes in electric furnaces." W. B. HAMILTON & J. HOLLAND. May 25th.
7,547. "Electric switches." BRITISH THOMSON-HOUSTON CO. (General Electric Co., U.S.A.). May 25th.
7,548. "Multi-speed alternating-current motors, applicable to electric propulsion of ships." BRITISH THOMSON-HOUSTON CO. (General Electric Co., U.S.A.). May 25th.
7,557. "Terminal for electric conduit." F. I. JOHNSON. May 25th.
7,558. "Forming arcs or other relatively low-voltage electric currents across a gap or other resistance." DUBILIER ELECTRICAL SYNDICATE. May 25th. (U.S.A., August 15th, 1916.)
7,563. "Electrical timing devices." L. C. BYGRAVE & RELAY AUTOMATIC TELEPHONE CO. May 25th.
7,571. "Battery charging." CUTLER-HAMMER MANUFACTURING CO. AND IGRANIC ELECTRIC CO. May 25th.
7,591. "Insulators." J. SAYER. May 25th. (U.S.A., May 26th, 1916.)
7,606. "Cores for Pupin loading coils, magnets, &c." WESTERN ELECTRIC CO. May 26th. (U.S.A., May 26th, 1916.)
7,627. "Telegraphy." E. C. R. MARKS AND UNITED TELEGRAPH & CABLE CO. May 26th.
7,629. "Sparking plugs for internal-combustion engines." R. L. A. BOURGOGNON. May 26th.
7,636. "Apparatus for protecting electric installations." G. GILES. May 26th. (Switzerland, May 27th, 1916.)

PUBLISHED SPECIFICATIONS.

1916.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1,271. CARBON FILAMENT ELECTRIC GLOW LAMPS. C. O. Bastian. January 26th, 1916. (105,929.)
2,977. ELECTRIC HEATERS. E. C. R. Marks (Landers, Frary & Clark). February 28th, 1916. (105,936.)
4,759. DEVICE FOR RECORDING MUSICAL IMPROVISATIONS. C. E. Pritchard and A. E. Willmer. September 30th, 1916. (105,938.)
4,788. DYNAMO-ELECTRIC MACHINES. H. Chitty. March 31st, 1916. (105,942.)
4,948. APPARATUS FOR AUTOMATICALLY IGNITING AND EXTINGUISHING ELECTRIC LAMPS. F. C. Farge. July 10th, 1915. (Addition to 24,223/12 and 4,828/16.) (100,883.)
6,129. METHOD OF OPERATING ELECTRODES FOR PROJECTORS. E. A. Sperry. April 28th, 1916. (100,781.)
6,131. ELECTRICAL RESISTANCES. A. H. Curtis. April 28th, 1916. (105,946.)
6,150. METHOD OF AUTOMATICALLY TAKING UP SHRINKAGE OF COILS OF ELECTRIC TRANSFORMERS AND OTHER ELECTRIC APPARATUS. J. Hall & J. R. Kirk. April 29th, 1916. (105,947.)
6,229. APPARATUS FOR EFFECTING ENDOTHERMIC GAS REACTIONS BY AN ELECTRIC ARC. J. A. Currie. May 1st, 1916. (105,953.)
6,249. REVERSING CONTROLLER FOR ELECTRIC MOTORS USED ON PETROL-ELECTRIC CARS AND FOR OTHER PURPOSES. W. A. Stephens. May 2nd, 1916. (105,956.)
6,255. ELECTRICAL TRANSFORMERS. W. H. Wilson. May 2nd, 1916. (105,957.)
6,269. ELECTRICAL SELECTORS OR IMPULSE RESPONDERS. Relay Automatic Telephone Co. & L. C. Bygrave. May 2nd, 1916. (Addition to 9,345/15.) (105,959.)
6,328. AUTOMATIC TELEPHONE SYSTEMS. W. A. Burrell. May 3rd, 1916. (105,966.)
6,378. TIMERS OR INTERRUPTORS FOR MAGNETOS. C. Messerschmidt. October 12th 1915. (101,783.)
6,518. INDICATORS AND RECORDING INSTRUMENTS. S. R. Fletcher and A. Speight. May 6th, 1916. (105,986.)
6,771. INCANDESCENT ELECTRIC LAMPS. O. R. Sell. May 11th, 1916. (105,994.)
6,859. CARBON HOLDERS FOR ELECTRIC ARC LAMPS. J. White. May 13th, 1916. (105,996.)
7,712. SPARKING PLUGS. A. E. White (Wolverine Spark Plug Co.). May 31st, 1916. (106,006.)
7,796. ELECTRIC CONVERSION. S. Cabot. June 1st, 1916. (106,008.)
8,433. ELECTRIC HEATERS. Cable Accessories Co. & F. H. Reeves. June 15th, 1916. (106,011.)
8,960. MEANS FOR PRINTING IDENTIFYING MARKS ON INDIVIDUAL CORES OF MULTICORE ELECTRIC CABLES. R. Wood and Callender's Cable & Construction Co. June 26th, 1916. (106,016.)